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ABSTRACT

Papers presented at the 1985 conference of the American Association of Zoological Parks and Aquariums (AAZPA) are provided in these proceedings. The papers are listed alphabetically by first author in the subject index (table of contents) under these headings: birds (seven papers); conservation and research (eight papers); education (14 papers); exhibit and design (15 papers); finance and marketing (9 papers); fish (two papers); graphics (four papers); herpetology (three papers); horticulture (five papers); mammals (22 papers); management (seven papers); trustees (three papers); and miscellaneous (four papers). In a separate section is a group of 20 papers presented during poster sessions (and including only those papers submitted in sufficient detail) and an evaluation report of the First Special Coordinator and Studbook Keeper Workshop convened at the National Zoological Park's Front Royal facility during the summer of 1984. Black and white photographs and various graphs and tables are interspersed throughout the text. (JN)

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FOREWORD

The AAZPA is pleased to provide these 1985 Annual Conference Proceedings to all its Institution and Society members. We are also providing a complimentary copy to those speakers on the formal program who presented their papers to us for inclusion in these proceedings.

The 1985 Columbus Annual Conference was the most successful to date and had a record number of delegates in attendance. Columbus Zoo Director Jack Hanna, the members of his governing authority, the Columbus Zoo staff and the energetic Columbus Zoo Docents and volunteers provided us with an outstanding conference and social activities. AAZPA is deeply indebted to John Becker and Camille Smith for their assistance in coordinating the many conference activities and the smoothness with which our delegates were registered.

The program is, and should be, the highlight and focal point of an annual conference. There were more papers presented by more speakers representing more institutions than at any conference in the past. The Conference Program Committee was co-chaired by Dr. Maggie Snyder, Columbus Zoo, and Don Kuenzer, Cleveland Metroparks Zoo, who assembled an outstanding group of speakers and provided the delegates with an extremely fine mix of subjects addressing the latest state of the art in zoo and aquarium management. They were very capably assisted by Peter Crowcroft, Stephen Iserman, Daniel Moreno, Judith Breuggeman, Betsy Dresser, Wendy Fisher, John Lewis, David Bender and Gordon Hubbell.

The AAZPA expends considerable time and financial resources in compiling the Annual and Regional Conference Proceedings; but we feel such is an appropriate expenditure of time and money, because the conference proceedings become reference works in zoo and aquarium libraries and help to record the growing professionalism evidenced by those concerned with zoo and aquarium management.

Without the dedication of many persons, including those on my staff, such projects would not be possible. I take this means to thank all of them for assisting in this endeavor, as well as those who worked so very hard in making the Columbus Annual Conference a resounding success.

Robert O. Wagner
Robert O. Wagner
AAZPA Executive Director

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Obvious errors in the typing of manuscripts have been corrected by the AAZPA office staff. However, the Association is not responsible for the contents of this publication. Questions with reference to the presentations contained herein should be directed to the individual submitters.

STATE OF THE ASSOCIATION ADDRESS

Columbus, Ohio - 1985
Robert O. Wagner, AAZPA Executive Director

It is always a pleasure for me to address our assembled delegates during the course of the annual conference and to present the State of the Association Address. Such permits me an opportunity to provide an up-to-date report on our status and my perceptions with respect to both short- and long-term goals.

Delegates, you are a part of the largest assemblage of AAZPA members in our 61-year history. As a matter of fact and although the totals will not be available until the middle of this week, nearly one-fourth of our total membership is gathered here in Columbus. Jack Hanna and John Becker, ably assisted by their fine staff, have provided us an excellent forum to share information on zoological park and aquarium management. The Columbus Zoo Association, led by Bill Wolfe and Dr. Joe Cross, Chairman of the Board and President respectively, and supported by dedicated persons like Mel Dodge, Blaine Sickles and others, has greatly assisted me and my staff and the Columbus Zoo staff in organizing this conference. Those gentlemen have certainly gained my admiration and respect. Moreover, the Columbus Zoo docents and other volunteers, including Molly Widdis, Kathy Majors and Camille Smith, to single out just a few, have worked for this conference every bit as hard as the paid staff members. Because of the close proximity of the Columbus Zoo to the AAZPA Executive Office, I suspect I visit it more frequently than any other. I am sincere when saying that it is difficult to discern the differences in the Columbus Zoo volunteers and zoo association members from the paid staff.

The state of Ohio is blessed with outstanding zoological facilities. I urge delegates to take advantage of this unique opportunity to visit as many of these excellent facilities as possible. All of them have issued you a sincere invitation. Mayor Dana Rinehart of Columbus, James Barney, Director of Recreation and Parks and Governor Richard Celeste are to be congratulated for their support of the Columbus Zoo and assistance in hosting this conference. Moreover, I salute Governor Celeste and his administration for the reception being given to the concept of the International Center for the Preservation of Wild Animals.

When more than 1,000 professionals and support people gather for the purpose of addressing zoological park and aquarium concerns in but five days, conference planning becomes extremely complex. I applaud the outstanding efforts of Dr. Margaret Snyder and Don Kuenzer, co-chairmen of this year's Conference Program Committee for their efforts in our behalf. Supported by their colleagues on the Conference Program Committee, they have assembled an outstanding group of speakers, moderators, panelists and session leaders. Those of you who have been involved in planning a program of this magnitude readily understand the details involved. Nearly 110 speakers will address you during the next five days. Fifty-one are representatives from our member institutions who will share with you their concepts on zoological park and aquarium management and concerns for saving rapidly vanishing species of wildlife. Concurrent sessions are an absolute must to accomplish the task at hand. In response to concerns expressed by a few with respect to concurrent sessions, we published an advance copy of the conference program in the August edition of Newsletter. Such early notice was provided to assist the delegates in planning their course of action prior to arriving here.

Next year, the Association will embark upon a new phase of operation with respect to annual conferences. Incoming President George Felton has determined that a restructured Conference Program Committee, with continuity of members serving on the committee, will add immeasurably to its effectiveness and ease the burden caused by selecting a chairman for only a one-year term.

In another area offering the delegates an opportunity to better fulfill their asperations while attending an Annual Conference, I strongly urge that you attend those committee meetings of specific interest to you. It is during such meetings that the course of action for the coming months is established - subject to the approval of the Board of Directors. There are only a few committee meetings that are restricted to members of the committee. Please pay particular attention to the printed program for the times and places of committee meetings and notice those few that are closed. We have also initiated another service to address concerns expressed by delegates in the past. Located on tables near the exits of this room are copies of the Business Meeting agenda for Wednesday afternoon. There is a sufficient supply for all delegates. Please pick one up on your way to the coffee break. Look it over and be prepared to address any items of concern during the Business Meeting; but because such time is always extremely limited, your best opportunity to become involved or to express opinions is during the conduction of the committee meetings.

Since we assembled in Miami, Florida this time last year, much has been accomplished. Legislatively, we are better off than at any time in the history of the Association. We have established and are maintaining close working relationships with those federal regulatory agencies which have jurisdiction over various aspects of zoological park and aquarium management and the animal species we are so fervently attempting to preserve. We have strongly supported the reauthorization of the Endangered Species Act through our participation in a coalition of conservation- and environment-oriented organizations. Individually, many staff members of zoological parks and aquariums have supported the Act's reauthorization through their local Congressional delegations. For the first time, AAZPA was active in the CITES meeting recently held in Buenos Aires, Argentina. We had a four-member delegation consisting of Drs. Don Bruning and Warren Thomas, co-chairmen, and supported by Edward Asper and Barbara Heffernan. They performed admirably in behalf of the AAZPA and more deeply immersed the Association in international wildlife concerns. Additionally, and of equal importance, the Board of Directors carefully reviewed each issue coming before the CITES assemblage and offered its collective guidance to our delegation. On behalf of the Board of Directors, I acknowledge the fine efforts of our CITES delegation and express to them appreciation from our membership. On the whole, the CITES meeting was gratifying in terms of international conservation measures. Its unique working relationship with the international conservation community is absolutely essential to the preservation of wild animal species and the habitats so vital to long-term survival. CITES, along with the United States Endangered Species Act, provides documented evidence of the growing concerns for wildlife.

In another important area, Ed Asper and William Braker represented the Association's interest at the International Whaling Commission meeting recently held in Bournemouth, England. Both these gentlemen are saluted for their excellent representation of the Association's concerns with respect to the appropriate protection of whale populations. As is the case with the CITES delegation from AAZPA, the individual institutions provided the expenses for participation, and I am personally in their debt for such high-level financial support made available to the Association.

Rapidly changing legislation causes the Association to spend considerable time and effort in keeping its members apprised of regulations and those species extended coverage by various federal regulatory agencies and CITES. To meet that responsibility, the Association published the AAZPA Manual of Federal Wildlife Regulations a number of years ago. Since the publication of the Manual, we have incorporated several measures to attempt to keep the information in the Manual current. The first of those involved a process of printing updates and distributing such information to those possessing the Manual. Additionally, members of my staff, the Legislation Committee Chairman, staff members of George Steele Associates and Alan Shoemaker have individually and collectively published information in Newsletter with requests that members physically update their Manuals accordingly. Both measures worked fairly well. However, it became evident last year that the Manual would require a complete overhaul. Wilbur Amand, Don Bruning, Alan Shoemaker, Linda Boyd, Kris Vehrs and I met last winter in Columbia, South Carolina to address the issue. It was determined that we would completely recast the Manual. Such has recently been accomplished. Kris Vehrs brought the regulatory portion up-to-date, and Alan Shoemaker and members of my staff recast the taxonomic portion. The revised Manual is a two-volume set; the taxonomic portion in one binder and the regulatory section in another. The new publication will be available before the end of next month.

During the past year, the AAZPA, under the leadership of Ed Schmitt and assisted by Don Bruning and George Felton, established a Clearinghouse for the purpose of assisting the U.S. Department of the Interior with its seizures of wildlife. In large measure, such seizures involved birds. One of the most notable of those cases concerned black palm cockatoos. The amount of legal work, arrangements and details involved in that particular matter is mind-boggling. I have nothing but praise for Ed Schmitt and those assisting him in such an endeavor. Perhaps of more importance, though, is the fact that a small group of black palm cockatoos was returned to its country of origin. Such was accomplished by the Fish and Wildlife Service and a number of zoological parks, particularly by the excellent efforts of the New York Zoological Society, specifically Dr. Don Bruning. According to our information, this is the first time that confiscated wildlife was returned from whence it came and again underscores the growing professionalism on the part of the Association and its members.

On Thursday evening, President Turner will turn over the reigns of AAZPA to George Felton. Additionally, Chuck Bieler, Ed Asper and Don Bruning will retire from Board service. Coming onto the Board are Lee Simmons, Bob Bean and John Prescott. It is always difficult to have outstanding contributors to the Association's efforts leave Board service, but it is gratifying that such a fine group of persons are coming on to assist in the administration of the Association's programs. One of Elvie Turner's goals for his term as President was to make the AAZPA more visible in terms of zoo and aquarium management and to make its programs more understood by the public. He appealed to the delegates at the Miami Annual Conference to assist him in such an endeavor. I believe that much has been accomplished in this regard. While I have not tracked the numerous accomplishments in individual public relations endeavors, I believe that AAZPA was more visible during the past year than at any time in its history. We have received much exposure through both last year's and this year's Public Service Announcements. Those of you who have not yet seen this year's PSA are urged to do so as soon as possible. It is truly outstanding. The voice-over was provided complimentary by Burgess Meredith, and the entire project was accomplished through the efforts of Jackie Hill and Sea World, Inc. Additionally, there have been numerous articles appearing in major publications, both magazines and newspapers; and AAZPA programs have been highlighted on several network TV shows, including Audubon's excellent program.

During the 1980 Annual Conference in Chicago, Illinois, the Association's voting members overwhelmingly adopted an amendment to the Bylaws with respect to Accreditation. During the five years following that vote, we have received nearly 100 applications for Accreditation. That amendment carried with it the caveat that institutions not qualifying for Accreditation prior to 31 December 1985 could not continue as Institution members of AAZPA. That date is nearly upon us. Indeed, we have approximately 100 days, and some 15 institutions will automatically remove themselves from AAZPA membership. Contrary to some, such is not the fault of the Board of Directors, Accreditation Commission or the Executive Director. Nothing could be further from the truth when examining the facts. The mandatory Accreditation requirement was placed in the Bylaws at the conclusion of a vote in Chicago, Illinois. Those who have not submitted their institution's materials for review by the Accreditation Commission, or those that have processed and failed, are responsible for the end result. As one who has been deeply immersed in the Association's Accreditation program, especially since 1975, let me assure you that Accreditation is the single, finest program ever enacted by the AAZPA. It has been of immeasurable value to the vast majority of the institutions processing for Accreditation. Over and over again, institutions receiving Accreditation, as well as those not successful the first time, report the excellent impact the process of Accreditation has had upon their institutions, staff members and governing authorities.

In addition to the Association's strengthening of its programs through Accreditation, the voting members of AAZPA overwhelmingly adopted Bylaws amendments last January. Those included more stringent levels of membership requirements and a detailed review of all others possessing AAZPA membership who hold wildlife in captivity or who traffic in wildlife specimens. In fact, all existing animal supplier members of AAZPA will be required to reapply for membership before 31 December 1986. In general terms, animal supplier members and those related organizations holding wildlife in captivity will be subjected to carefully structured and detailed inspections somewhat similar to those required under the Accreditation program.

Thus, by 1 January 1987, AAZPA will be able to stand proud in stating that all member zoological parks, aquariums, wildlife parks, oceanariums, related organizations and animal suppliers have been subjected to the scrutiny of our Membership Committee or Accreditation Commission and have proved their professionalism and commitments to our goals and objectives.

Again this year, we have distinguished members from the Institute of Museum Services here to help us. They will be participating in a panel discussion during the course of the conference. On a personal note, please allow me to express concern because only a few of you have accepted the opportunity accorded us by the U.S. Congress. We have spent considerable time explaining the conservation ethic of the zoological park and aquarium profession to the U.S. Congress. We have told them of the financial commitments our institutions are making for the good of wildlife. We support the legislative program of the American Association of Museums to the tune of $12,000 a year to assist them in telling the U.S. Congress of the financial needs of our members. Frankly, the Congress is not overly convinced of such needs because the track record of zoological parks, aquariums and other museums was bleak regarding grant applications. Such is especially true regarding the Conservation grants. While it is understood that the maximum of $25,000 per year is not sufficient to restore lost habitat or conserve a rapidly vanishing species, that is not the point. The point is that we say we need funds and the Congress says, "Do you really?" Please take advantage of this opportunity to show the Congress we mean business.

In closing, we are formally into our Conservation Endowment Fund program. Materials are developed and being mailed to all Institution, Society, Related Organization, Registered Animal Supplier and Commercial members. You will hear more on this during the Business Meeting and will have an opportunity to review the materials upon your return from this conference. Such monies are needed by AAZPA to fund conservation projects outside the scope of those funded through our regular budgetary process.

Lastly, I congratulate the retiring members of our Board of Directors for their dedicated service to the Association. I am also very proud of the progress our members have made since we last gathered and assure you that your continued support of the Association makes my service, both with and for you, a pleasure.

THE BROADER ISSUES OF CONSERVATION: CAN ZOOS MEET THE CHALLENGE

Introduction

Dale L. Marcellini, Curator of Herpetology
National Zoological Park

I am very pleased that the 1985 AAZPA National Conference can begin its paper sessions with one that concerns the most critical issue facing mankind: conservation.

The genesis of this session was more than three years ago at the Sixth Conference of the Association of International Zoo Educators in Tucson, Arizona. The theme of that conference was Nature Conservation in Zoos and Aquariums. Few talks, however, were on the topic of conservation. In fact, some educators were pessimistic about the possibility of zoos teaching nature conservation at all. As a result, a group of educators decided that they would like to explore together the topic of conservation education. To this end, a series of meetings on conservation and the zoo visitor was held at the National Zoological Park in 1984 and 1985. The principal educators involved were Jim Aiello (Burnett Park Zoo), Tom Brennan (Brookfield Zoo), Helen Freeman (Woodland Park Zoo), Janet Jackson (Philadelphia Zoo), Judith Kolar (Lincoln Park Zoo), and the organizer, Judith White (National Zoological Park). This is when I became involved as a participant in the discussions.

The consensus of the participants was that conservation is an urgent and complex issue that is commonly approached by zoos and aquariums in a very superficial, simple-minded and often self-serving way. Docent tours on endangered animals, going going gone signs and even the current emphasis on breeding endangered species are only conservation in a very limited sense: conservation with a little 'c'. It avoids the real underlying causes of the world conservation crisis.

These educators felt that zoos and aquariums needed to begin to think in terms of Conservation with a big 'C'. Conservation with a big 'C' takes a global view of The World's resources: plants, minerals, water, ecosystems, humans and wildlife. Conservation with a big 'C' deals with causes, not results.

This session, then, is a outgrowth of the thinking of these educators and is an attempt to bring the issue of big 'C' conservation to all zoo and aquarium professionals.

The four presentations were selected to first, identify and describe the world conservation crisis, second, to describe what one international organization is doing in an attempt to deal with the crisis, third, to discuss big 'C' conservation in a zoo setting, and lastly, to describe some of the measures that are already being taken to deal with broad conservation issues in zoos and aquariums.

WORLD CONSERVATION CRISIS

Thomas E. Lovejoy[1]

It is a striking irony that at the very time we are likely to lose a significant fraction of the species with which we share this planet, we are not only unable to give a precise estimate of the total number of species on earth, we cannot even estimate it to within an order of magnitude. With about 1.7 million described species, the estimate for the total runs between 3 and 30, the latter number being based on great diversity in tropical forest canopy insects only now being sampled for the first time (Erwin 1984).

The zoo profession is as familiar as any group with the roster of endangered vertebrates, but it is total species in peril that concerns this presentation: plants, squirmies and decomposers - the species which really run this planet, our illusions to the contrary. The difficulty is to make an estimate or projection that has some meaning and can be believable by reasonable open-minded citizens without scientific background.

Before approaching the present situation, it is important to note that there is increasing evidence that human generated extinctions antedate written history. A series of fascinating studies by Storrs L. Olson (1984) has revealed considerable numbers of avian extinctions on islands prior to European discovery; the mammalian subfossils appear to promise a similar story. The Hawaiian Islands lost half their complement of 90 bird species subsequent to Polynesian arrival and prior to the arrival of Captain Cook. Even more interesting, Henderson Island in the South Pacific lost three species of birds, a storm-petrel and two pigeons, during Polynesian habitation, but those inhabitants had moved on leaving Henderson vacant at the time of European discovery (Steadman and Olson 1985). The evidence is all circumstantial but the pattern repeats itself sufficiently to give credence to it as a generality. The use of fire in New Zealand and Madagascar may well have taken a toll of which there is no record.

It is the wet tropics of course which is the worst part of the scene. With half or more of all species on earth occurring in tropical forests, a deforestation rate estimated to be 25-50 acres/minute, and tropical forest already on the order of half gone, there is plenty cause for concern. It probably was not just selective extinctions: all of us can relate examples of personal experiences of forests here one day and gone another. Michael Robinson will give you a detailed consideration of the tropics this afternoon. Madagascar with 90% of its forests species endemic, and only 10% of its forest remaining, is second only to the species rich Atlantic forest of Brasil of which maybe 2% remains. If one takes the classic species/area curve one can apply its rough rule of thumb that a species number goes up or down by a factor of two when area increases or decreases by a factor of ten. By this approach Madagascar forest species should already be reduced to 1/2 and the Atlantic Forest to about 1/4. As far as we know it has not reached such a sorry state, and that makes sense because the loss of species from habitat fragments can take considerable lengths of time subsequent to isolation. That means there is time to let forest fragments expand in area and save a lot of the species before they are irretrievably lost. On the negative side we know the remaining forest in both places is not a single block, but rather a whole series of fragments subject to yet further elevated rates of species loss.

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This kind of picture obviously leads to a major extinction problem. Simberloff's (1984) recent careful estimate suggests present deforestation could lead to loss of about 12% of the 700 bird species in the Amazon, and 15% of the plant species in South and Central America. E. O. Wilson (1985) estimates the current extinction rate at about 400 x that of recent geological times. Many other estimates range higher. The critical point is, despite a couple economists who believe extinction can only happen if someone is watching each species, that all field biologists who have addressed the problem concur that it is large - even ones who disagree violently on other matters.

This does not consider any of the problems that may be wrought by disrupting regional processes, like the forest/rainfall relationship in the Amazon, or the various changes such as CO_2 levels contributing to a greenhouse effect. That there are elevated CO_2 levels and that they are likely to continue rising is no matter of debate; the kinds of changes in climatic patterns are. All agree that the as much as $4.5^{\circ}C$ rise will not be uniform over the planet. Temperature and rainfall patterns will change, and vegetation associations and species would normally move. But to where in our now largely man dominated landscapes? Further worry is added when one considers evidence that during past climatic changes, species did not necessarily move together. It is hard to feel comfortable when a great ecologist, G. Evelyn Hutchinson, says he does hope the various things we are doing to the atmosphere will cancel each other out.

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All of us involved with zoos are concerned automatically by virtue of our fascination with and affinity to life on earth. There are various arguments on behalf of biological diversity that I need not detail here. I will focus on only one, namely the importance of the full array of life as it manifests itself to biological science, with all that means for human welfare. E. O. Wilson (1984) has calculated that the amount of information in a single strand of *Mus musculus* DNA is roughly equivalent to that in all 15 editions of the Encyclopedia Britannica combined. Even simple ecosystems are orders of magnitude richer. There is no analog to such complex systems in the inanimate world. The loss therefore of even 10% of the biota represents a loss that would dwarf the destruction of the Library of Congress. Furthermore in the process the larger species with more complex biologies would fare less well than weedy species. We would lose perspectives on what is biologically possible - such as those provided by the large blue butterfly, the giant panda and a myriad of mutualist species in the tropics.

Hutchinson (1979) once commented that life on earth is so diverse that it is probably possible to find an example in nature for any model, and the interesting question thus becomes which models occur with which frequency and why - a very fundamental question that depends for its answer on life manifest in its fullest extent. The amount of extinction in prospect amounts to what is certainly the greatest antiintellectual act in our history - the Socratic cup of hemlock and the loss of the library at Alexandria are trivial in comparison.

An interesting example of our ignorance is that we can rarely answer that nasty question: what good is a particular species or its dangerous corollary which species are more important than others? This is even more so when the species is rare, a condition which has been described as ecologically nonfunctional, or even "ecologically extinct". Yet rare species are characteristic of all but the most disturbed of ecosystems. I would raise the possibility that perhaps their true meaning or value is only revealed during times of change.

I think of a little yeast in eastern Pennsylvania streams which is normally very rare. This is because it is able to reduce mercury in solution in aquatic systems and normally mercury is rare and the yeast presumably outcompeted. It of course becomes very abundant when mercury levels are high and deposits vacuoles filled with quicksilver on rocks as it "cleans up" the water. The yeast in fact makes itself rare again. Important for industrial pollution work, true; but also of value to the aquatic community which probably just has it by random events, or because such pollution events occur sufficiently frequently to maintain the yeast as a rare species in that ecosystem. I do not mean to imply that the presence of such species represents PURPOSE, but rather that the accumulation of such species should not be surprising - nor should our ignorance about them be a source of astonishment.

The extinction problem is rendered worse by our expanding human population which all expect to at least double before levelling off. The capacity of the land and waters to sustain these populations will be severely strained. Wonderful Costa Rica, the favorite example of a developing nation which did the necessary job of setting up a national park system, has also had very high rates of deforestation. She will be forced to import timber or invade the parks unless trees are planted immediately. If this is Costa Rica's predicament, many other nations must be in worse condition. We need to worry about how Kenya's great parks can hope to survive in the face of the world's highest population growth-rate.

Indeed, the international debt, probably now in the $800 billion dollar range, is both symbolic of the interconnectedness of nations and is a stranglehold on their future. Forced to obey strictures of the International Monetary Fund, necessary conservation programs are cut or do not grow as they should. Most foreign exchange earnings go to service the debt, so economies grow slowly, as do the standards of living necessary for so many things, including sufficient freedom from immediate want that topics like environment can be considered. I continue to dream about the possibility of discounts applied against the debt, for natural resource and conservation projects paid for by developing nations with their own soft currencies. After all money is already there, why not put it to good use?

I do not want to indicate there is no hope. Most of us in conservation would quit our jobs if that were so. The problem is that the scale and rate of our predicament is so great relative to the resources and activity we have been able to generate. We really have become a rogue species crashing about the biosphere generating extinctions. Locally, and beginning on a greater if not quite yet a global scale, we are beginning to generate patterns of abundance characteristic of weedy species and disturbed communities. That is, with a small number of very abundant species and few others, instead of the more mature community relative abundance curves where there are a great number of species of intermediate and rare abundance. In the tropics, rare species accumulate to such a degree they make up perhaps half of a tropical forest ecosystem - it is no wonder that the extinction problem is paramount there.

I am often asked by novitiates if we will cause our own extinction through this behavior. I certainly do not think so, as there seems abundant evidence of the capability of humans to adapt to rather miserable conditions, and to survive even in the face of staggering mortality rates. Nonetheless it is worth noting that natural resource problems can be a festering source of social and political unrest. I have said without exaggeration (except that deriving from the lack of details of the biology of our migratory birds), that one could have predicted Central America's problems (as opposed to the modifications we have imposed) from looking at what was happened to our migratory forest songbirds. And it is not too far from that to pressing the button and triggering nuclear winter. With regard to the latter, it is interesting to note that the realization of the possible darkening of the atmosphere came from consideration of the meteor hypothesis of dinosaur extinction. That shows to a limited extent even extinct species can be useful.

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THE WORLD CONSERVATION STRATEGY AND THE ROLE OF INTERNATIONAL AGENCIES

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Having just had a thought provoking introduction to the importance of conserving biological diversity and the current trends toward the loss of the species and ecosystems which make-up the living fabric of our planet, I would like to introduce you to the problems which conservationists face in their efforts to come to grips with these issues.

By now, I expect that each and every one of you is motivated to ask three questions. First, what is being done to help resolve these problems? Second, who are the active participants in this important work? Finally, how can I and my organization become involved?

I hope that I am not being presumptuous in expecting you to ask yourself these questions. Addressing these questions is the first step toward taking the actions which are needed to resolve these critical problems; The actions which in turn can change the course of the future by dramatically decreasing the scale of the ecological losses which we are now facing.

This morning I would like to briefly discuss some of the answers to these three questions.

First, let us begin by considering some of the actions that are being taken to solve the planet's conservation dilemmas.

In 1980, the International Union for the Conservation of Nature (IUCN) in cooperation with the World Wildlife Fund and United Nations Environment Programme, published the World Conservation Strategy. The WCS is a document which is the product of an extensive consultative process which brought together the differing views of environmentalists from around the world to shed a new light on the constantly growing problems that our planet is facing. The Strategy represents a major breakthrough in the thinking of conservationists as it provides the framework for a new approach to worldwide economic development in a sustainable balance with sound ecological principles.

The Strategy explains the importance of conserving our living resources and their importance to human survival, at the same time identifying the world's priority conservation issues and the main approaches to resolving them. It presents the process of ecologically sustainable development in a way which can be easily understood by conservationists, developers and government officials.

The World Conservation Strategy has three main objectives which can be summarized as follows: maintaining essential ecological processes and life support systems on which human survival and development depend; preserving genetic diversity as the base upon which species and ecological processes depend; and, ensuring the sustainable utilization of species and ecosystems.

These goals must be achieved with the utmost speed and effectiveness if we are to reverse the current trends which are decreasing the earth's ability to support life in both industrial and developing countries.

I do not intend this morning to present you with a complete list of the priority actions which are recommended in the Strategy but rather I would like to give you a sampling of the issues and recommendations.

As you are aware from the previous comments, the problems faced in tropical ecosystems are severe. The Strategy recommends as a priority action, the conservation of these forests in West and East Africa, South and Southeast Asia, Central America, Mexico and South America.

In those countries where parks have been established it is important to develop programs so that local people can benefit from these protected areas and their buffer zones. Unesco's Man and Biosphere Program (MAB), provides an exemplary approach to this type of integrated conservation. The needs and benefits of rural people are actively integrated into the management of each of MAB's Biosphere Reserves.

In other areas it is becoming ever more critical to design and strategically implement reforestation programs. While these efforts are generally extremely costly they often represent the only possible resolution of environmental problems caused by years of waste and misuse of fragile tropical forests.

The World Conservation Strategy also focuses attention on the important matter of international conservation laws and the means of implementing them. Intentional conservation conventions provide both important opportunities and difficult challenges. By their very nature these laws are self-imposed and thus enforcement is based on self-restraint and goodwill. As such, it is often difficult to develop agreements which have substantial strength and it can be even more difficult to oversee and insure proper local enforcement.

CITES, the Convention on International Trade in Endangered Species is one such law which is, I am certain, familiar to all of you. Other examples include the World Heritage Convention which recognizes the need for all nations to set aside and protect areas which represent unique natural and cultural assets for all of mankind. The Migratory Species Convention is perhaps an even more interesting example of the need for international cooperation because it attempts to resolve concerns which can only be dealt with on a multinational basis.

In yet another section of the Strategy there is a discussion of the importance of gaining local support and participation as a means for building support for conservation. I will refer to this again latter, when I begin to speak about "what you can do".

With this brief background on the types of actions that are needed and being taken, I would like to move my discussion on to the matter of the second question, namely, who are the active participants in international conservation work.

In the next few minutes I will only be able to mention a few organizations, by no means an exhaustive list.

Let me begin with the IUCN. This organization has some very special characteristics because it is an organization of institutions. The IUCN currently has approximately 525 institutional members, some 60 of which are national governments, 125 government agencies and roughly 340 non-governmental organizations. These members meet every three years in a general assembly to discuss conservation matters of global concern and to establish the policies and action priorities for the Union as a whole. The IUCN's Secretariat is based near Geneva, Switzerland where it is housed jointly with the World Wildlife Fund in the World Conservation Centre.

The IUCN is much more than an organization of conservation agencies, it also encompasses six technical commissions that contain almost 2,000 experts from around the world in the fields of species survival, protected areas management, environmental planning, ecology, environmental policy and law and education. Through its Secretariat and Commissions, the IUCN conducts a variety of major program activities. For example, the Species Survival Commission and Conservation Monitoring Centre constantly reviews the status of species and ecosystems throughout the world; while at the same time, the Conservation for Development Centre has been working with governments in almost 20 countries to develop national conservation strategies.

Founded in 1961, World Wildlife Fund (WWF) has become the world's largest international conservation organization and foremost group committed to the preservation of endangered species and habitats. WWF has its international headquarters in Gland, Switzerland, and with 24 WWF affiliate offices located throughout the world, has accounted for the distribution of over $85 million in support of some 3800 scientific research, education, and wildlife and habitat preservation programs in over 130 countries.

WWF's scope is the conservation of nature and the natural environment in all its forms: fauna, flora, landscapes, soils, water, air, and other natural resources. They aim to create awareness of threats to the environment and to generate and attract on a world-wide basis the strongest possible moral and financial support for safeguarding the living world and to convert that support into action based on scientific priorities.

Since its founding, WWF has served as a catalyst for conservation action, brought its influence to bear on critical conservation situations, and provided a link between conservation needs, the scientific resources necessary to meet them, and the governments and other authorities whose action is needed.

The United Nations Environment Programme was established in 1972. Its mandate is to keep the world environmental situation under review in order to ensure that emerging environmental problems of international significance receive appropriate consideration by governments, and to safeguard the environment for the benefit of present and future generations. UNEP plays a catalytic and coordinating role with the organizations of the United Nations family and administers the "environment fund", which is based on voluntary government contributions. For your information, the U.S. contribution to this fund has remained stable at $10,000,000 for the past 13 years with no adjustment whatsoever for the substantial inflation which has occurred over this period.

UNEP's environment fund assists in promoting activities relating to environmental assessment and management, including priority programs in: environmental health, terrestrial ecosystems, environment and development, oceans, energy and natural disasters.

Now, to the final and perhaps most important question, what can you and your organizations do to help resolve the environmental problems which are facing us globally? Although I will not treat this in depth as the speakers who follow will be treating this more fully, I would like to give you a few thoughts because zoos, aquariums and botanical gardens present a special opportunity for one of the most important steps in achieving long term success with our efforts, namely building support for conservation.

Building support for conservation involves creating awareness, educating and motivating people to action. Because, relatively little can be achieved for conservation without an adequate base of knowledge and understanding. Each new generation must learn for itself the importance of conservation or risk the health and ecological stability of the planet. For while we most certainly can survive without being able to read or write if we lack environmental literacy we shall not long survive.

The potential role of the AAZPA and its members in environmental education is extremely important. Your institutions represent the potential for bringing the message of ecologically sustainable development and conservation to millions of people.

At the same time, because the people who visit your institutions are self-selected, you have a unique opportunity to actively focus your efforts on people who are already interested. Thus it is even more feasible to educate your visiting publics to the problems of conservation at the local, national and international levels.

And, it is only with the support of such an educated public that the resources will be made available to undertake the measures which are needed to solve the natural resources management issues which confront us today.

I would like to close with a quote from the late Indira Gandhi, not only an important leader of her country but a leading light for conservation in the developing world.

"Fortunately, there is no real conflict between development and conservation. Enduring development requires a more thoughtful and thrifty use of resources, greater care in the planning and siting of industrial and other projects, measures for stopping pollution, and the bettering, rather than replacing, of existing life styles and traditional working methods.

Recent years have seen an increasing awareness of these issues. The various movements for the conservation of nature and the redressing of the balance of nature which has been grievously upset are not impractically idealistic. These movements plead for saner, more practical measures to translate oft-repeated statements of goodwill into actions in time to save the earth and our species...

The worldwide movement for conservation is working against great odds, facing criticism and sometimes ridicule. Its influence grows but not sufficiently. ... Remedies for the world's environmental problems are known, but there is an immediate need ... for international cooperation, for a joint effort by many minds and organizations throughout the world to put the remedies to work."

I will leave you with this charge from Prime Minister Gandhi to join in this most important work.

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FACING UP TO CONSERVATION EDUCATION

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Brookfield Zoo

We are innately and culturally conditioned.

What you have just felt and experienced is an example. It is behaviorally inherent that we address one another frontally. To do otherwise is to communicate disinterest in communicating and, anthropocentrically, hostility and contempt on the one hand, or timidity and fearfulness on the other. I suggest that we in zoos and aquariums have been practicing this behavior, for the latter reason, in respect to conservation. We somehow sense that for all the notoriety that certain admirable conservation activists attract, they are not part of the mainstream of our culture, whereas we are. We do not wish to offend by being counterculture, we are fearful of indicating that we are the problem--we as a species rejecting natural control of our population--we as a culture devoted to self-gratification in material terms that mean exploitation and destruction of the environment worldwide.

We have become the greatest communicators on earth--even the great whales give way before us as we circle the globe with our messages, messages that mostly speak of disaster in our relations with one another, and, in our western culture, now exported globally, with the environment. By the latter I do not mean the reports of famine in Ethiopia or floods in Bengal, but the messages of blind consumerism.

As we are well aware, the most potent mass communications medium we have is television. And in our culture it is used to foster life styles not realistic for mankind as a whole, life styles and practices in drawing on nature's capital that exacerbate troubles between peoples locally and internationally. Except in a super-psychotic society, no one wants to be told that they're bad, bad for the rest of the world. Yet this is a large part of the message that conservation brings to us if we face it squarely. This message is unacceptable in our culture and in other less fortunate cultures and societies. Consequently, we as a people only tut-tut in regard to species threatened with extinction, and shudder momentarily when there is a Bhopal or Three-mile Island to dramatize an on-going Silent Spring.

What to do? I believe many, if not most of us, in zoos and aquariums feel that we are concerned about the larger issues of conservation and that we want to face their challenges. We have already committed ourselves and our institutions to conservation *and* education--it's in our charters, it is practiced in our SSP's, it is evidenced by the presence of our two distinguished guests from World Wildlife Fund and IUCN. Why do you suppose they are here?

Zoos and aquariums are wonderful opportunities. We provide an institutional base for potentially influencing the attitudes and outlook of millions, and we know it. Yet most of us feel, too, that we're not getting the message across. Why our sense of frustration? I think there are two sources. Curiously, one source is the tremendous effort we've made to redirect our animal collection operations from the acquisitive to the productive in conservation terms.

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I am suggesting that the greatest contribution of the Species Survival Plans is not the survival of animals but the education of many zoo people about the biology of survival as we grapple with the requisite demographic and genetic principles. We feel the need then to transpose and transfer that newfound feeling and realization of awesome responsibility as custodians of animals as species to our communities and zoo visitors in the even larger dimension of custodianship of the earth and the consequences of failure in planetary-wide extinction.

Another source of frustration, I believe, is that we recognize the contra- if not countercultural job we have ahead. It is not sufficient to have naturalistic exhibits, nor innovative educational programs such as you will hear about in a few minutes and over the next few days. We're going to have to invest more and commit more if we are to communicate effectively. In truth, we're going to have to revolutionize our institutions and ourselves for this communication job with the public, just as we've started to do through the SSP's for the animals themselves.

We already know a great deal about our task. Most of us know something of our audience, a few by now know something of our majority non-audience. We have information from Kellert and other sources that the opportunities to affect attitude formation are limited. Primarily they involve the young. But there is always the potential for influencing the parenting adults by peer pressure, by setting in place examples of what trend-setters and leaders value.

I suggest that in general our acquisitive society is susceptible to a conservation education strategy based on possession of riches. The problem is that we already have the riches, and the concept of loss of nature's diversity, the loss of species is remote. There is no feeling of ownership or proprietary rights, much less stewardship or responsibility for our legacy. Contrast the response to well-run animal adoption programs in our zoos to contributions by the public in the same institutions for conservation of the panda or condor or hairy-nosed wombat. The animal adoption program has immediacy--the individual animals belong to the public and zoo membership, and zoo people are to look out for their welfare.

Adopt-a-species seems a strange notion at first. But why not? By force of the environmental pressures and international agreements we are already narrowing our exhibitions of species diversity. As each collection features fewer species and can advertise its specialities, there is the possibility of instilling prideful stewardship in the local public. Consider the notion that endangered species today are the royal species of the past, and the public as a whole has assumed authority and responsibility formerly the province of dukes and kings.

I strongly suggest that we must be consistent in our ethic. A child quickly learns to spot the duplicities in adults and their society. We cannot espouse crass consumerism, and practice waste of materials, and then expect a rounded view of why we should keep the colugo or kagu or tuatara. In other words, the lesson really begins at home. The zoo can strive to be the conservation center for the community, but it must practice what it preaches.

Recycling, composting, energy generation, a resource conservation consciousness throughout the organization are consistent parts of the caring institutional persona we wish others to emulate. Junk souvenir merchandise, so-called junk food clutter our zoos. They are not consistent.

On the professional front, I think we must move in the same vein. If these animals are part of the commons, a shared responsibility, then we must move out of the ordinary marketplace in our transactions or face the tragedy of the commons, as Garrett Hardin has described it, in the loss to greed. We claim that the animals are priceless--let's practice it, and remove the notion that money is an appropriate value system. The integrity of the earth's ecosystems is the ultimate criterion of value in our relationships with the natural world. Maintaining animals outside of their natural systems for educational purposes is by and large what zoo's are about. That is our business. But in terms of survival of our business and, incidentally, the animals', we must not only preach but practice conservation.

The business is not without costs in maintaining animals and this, I suggest, could be the basis for interzoo transactions. Costs for the requisite investment in facilities, trained personnel, parallel field studies and field conservation education, and research and education in the zoo. All can be estimated and commitments made in the context of consortia and species management groups. Some of this sort of initiative is already occurring. Our European colleagues have renounced monetary transactions for okapi. The Sumatran Rhino Trust is not just a crapshoot for possession of rare stamps. And many gratis transactions are taking place with other creatures.

We should let this be known, for fundamentally the market ethos cannot be ours. It is inconsistent with a plural responsibility for management of earth's riches, riches we are given to experience and enjoy for brief individual lifetimes but which we as a species must reflect on as part of a cultural heritage to be passed on to future generations.

I suggest that we begin at home in another sense, too. I trust that we do agree that our principal contribution to conservation is not likely to be the number of golden lion tamarins returned to the wild but rather the education of millions about the underlying causes for such an extraordinary effort. If we so agree, then why is it that we by and large cannot qualify as educational institutions worthy of public support? Why don't we change the laws and people's regard so that we are so considered?

Most of us work under or with Trustees or city councils or park boards or volunteers. These are public interest groups. It is our job to educate them about the public interest of our institutions and the conservation educational values in particular. They are the people who can carry the message to the legislators and voters. Where is the trustee education program in your institution? And think about what's involved in such a program--we can't say you're a bad capitalistic example for your children, eating up the environment. We can say you can rise to a leadership role more meaningful than personal wealth. We and they have power to influence a world to good for this and future generations.

To sum up, we've been timorous in communicating conservation through our institutions because it is a countercultural message. We know, however, that zoos present a wonderful opportunity for communicating in the context of live animals and the positive affectional relationship of people and animals. Our revolutionary messages on conservation in its broader dimensions will likely be best received if we practice what we preach, if we start at home with our ethic. This means changing the operational practices in our institutions and profession to reflect a global conservation ethic. It means change in the value system of our staffs, members, and public leadership.

The world needs a massive national and international commitment to conservation--the man on the moon pledge transferred to man on earth. We can provide an enormous boost to such an effort. Indeed, we can generate it by our own commitment and investment of institutional resources. Or, we can face the world, and then, turn our back.

CONSERVATION EDUCATION: WHAT'S NEW?

by

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Because the problems facing wildlife are so very critical and I knew the speakers preceding me would give a most thoughtful look at this crisis, I decided when writing this paper that the best thing to do at this point was to lighten the mood for a moment by telling you a joke about conservation.

But finding a joke has not been an easy task. Have you ever tried to find a joke about conservation? However, just as I was about to give up, I came across these words by Woody Allen. He said: "More than at any other time in history mankind faces a crossroad. One path leads to despair and utter hopelessness. The other to total extinction. Let us pray to have the wisdom to choose correctly." Now doesn't that brighten the whole morning?

I once learned there are seven signals which tell whether or not a person is crazy. The seventh signal is when an individual actually believes he or she can make a difference. I am here to ask you to join me in being a little crazy because I believe zoos and aquariums can make a difference in the broad picture of wildlife conservation. What I want to talk about today is the area of our greatest potential: education.

Of course we have already started on this. But what is needed now is a shift in institutional priorities, a shift to policies that emphasize a conservation message even if it seems temporarily to be at odds with the older, more comfortable way of doing things.

For instance, let us say a zoo has been given free television time to raise funds for a new exhibit. With this shift it is not enough to just give a show which entertains people while they donate money. Now it is also a golden opportunity for hometown viewers to learn about some current conservation issues. It doesn't have to be a doom and gloom message. It would be enough if those people understood that wild elephants need extensive habitat, that snow leopards need blue sheep and smelly goats, and that we need tropical forests for medicine, moisture and clean air.

But the impact would even be stronger if by donating to the zoo, they could also see a small percentage of their money go directly into a preserve project concerned with the same species as the ones in the new exhibit. We have all met individuals who will not give to captive situations but will donate to projects in the field. The important point to remember here is that this direct tie-in to the wild may actually increase donation dollars.

I have been told that we are already fulfilling our conservation purpose by the very fact that we are building naturalistic enclosures. Through this shift from barren cages, we are making it possible for the viewer to understand the interrelationship between a species and its environment and this automatically promotes conservation.

But let us look behind the words and examine the message. If all that was necessary for an understanding of wildlife conservation was a duplication of the natural habitat, then when someone saw a grizzly bear in magnificent Mt. Denali National Park, they should intuitively understand the importance of mountain habitat in conserving the grizzly.

How many of you truly believe this happens in a viewer's mind? And even if by some remote possibility it did, how many of you believe we can begin to replicate Mt. Denali?

However, no one will disagree that we should continue to build more naturalistic exhibits. It is a crucial step. But please let us take care that we do not fool ourselves into believing this alone will enable us to say we are making a major contribution to wildlife conservation. I have said this in previous papers but I'll say it again: if that is as far as it goes, what we are doing is building a better zoo.

Education programs should be expanded beyond the short term goal of just informing people there is a wildlife and habitat crisis. Rather they should point out that knowledge without action will be ineffectual. Our programs should illustrate that zoos are farsighted enough to realize the need to support quality projects, whether in their own backyard or on another continent.

An excellent example of this approach is the golden lion tamarin project. It successfully reintroduced captive-born individuals into a Brazilian forest. This is a major accomplishment in itself, but the larger impact is the conservation education message that went out internationally and locally on the need to preserve the forest.

Following is a summary of a report from Lou Ann Dietz, education coordinator in Brazil: Our activities have ranged from organizing press events inside the Reserve to producing for school children free notebooks with a tamarin cover and conservation message. We have aired public service messages, trained teachers in ecology and taught landowners how they can save on property tax by establishing private forest refuges. Schools have organized field trips to the Reserve. During one visit, a daring young tamarin came down from a tree, found a tree frog, and ate it in front of 25 ecstatic high school students. Although public enthusiasm is growing, we know the changing of attitudes and behaviors is a slow process that will have to continue long after most of us have returned to the United States. An energetic Brazilian biologist will continue the educational work she has helped to begin. An entire ecosystem may one day owe its survival to a handful of zoo-born primates.

To date, education in most zoos and aquariums has been primarily through the presentation of factual information in a knowledgeable but passive manner. Docents give tours; families take classes; graphics explain what the animal eats and does; visitors look, listen and read. Through this all there may be woven a theme of constant anxiety, telling about the ever increasing number of species that are becoming endangered and the critical state of the "real world."

But what about behind the scenes? Is our resolve to take action on a project weak, ready to be toppled over by whatever conflicting budget or political problem comes along?

If we are to play a viable role in the larger conservation arena, if conservation and education are indeed two of our major purposes, there is no choice but to move into direct involvement in current issues. This means moving out of the known passive stage and into one that may include risk, uncertainty and conflict. Initially there may be conflict of interest with some of our donors. Some of the projects may fail or be criticized. But the speakers before me have made it clear that the expanded role of education and action is necessary in today's world.

For those of you who still question why we shouldn't be provincial and just offer a better facility to our members and visitors, the answer is also clear. It is because the result several hundred years from now may be that the only place you can still see wildlife is in a zoo. Is that the end product we are working for?

Making this shift to broader quality conservation programs means work. For staffs, it necessitates meetings and workshops so that internal understanding is reached on the importance of active involvement by their respective institutions in conservation measures.

On the part of the public it means understanding their expectations so that we can develop programs which lead visitors beyond a simple appreciation to ones which motivate them to action. The advocate role says whether they agree or not, we do not want to leave their minds in neutral.

Philadelphia Zoo pilot-tested a program this summer in which two short plays were given adjacent to the zoo's main walkway. The goal was to present a message about conservation to visitors in an entertaining and memorable way. One play told the tale where in the village of Agfanafasville enterprising villagers grazed one too many cows on their village commons. In the second play Johnny Jones learns about the connection between the rain forests he loves to read about and the hamburgers he loves to eat. Viewers' comments included: "Thank you for the play and the treatment of a real subject." In the evaluation survey, 94% rated the plays as either excellent or good; 88% said they were entertaining; 76% said the message was appropriate. Clearly this method was a hit with the zoo visitor.

In the long run, exhibits and programming which touch all the senses may be the most crucial to visitor motivation. But these cannot be done effectively without substantial research and funding. On Tuesday morning there is a session dealing with the costs and benefits of interactive technology. This session will give a broad picture of what is needed to get people's senses energized; what I want to emphasize now is that it is a shift which needs priority funding if it is to be effective. Reliance on external grants is a temporary measure at best. At worst it is passing the buck.

Now I have a pleasant surprise for you--good programming also increases attendance. And there is even another flip side to the coin. Good conservation programs are fun. For example, every summer the National Zoo has a festival that includes mimes, drama, puppets and so forth for the zoo visitor. But as a direct result of the zoo's renewed dedication to involving the visitor more actively in conservation issues, the festival this summer focused directly on the plight of the tropical forest. It was called Tropical Pursuit and a continuous game was played as families walked around the zoo grounds. The overwhelming response as people finished was: we liked the game because we learned something new and that was fun.

Let's face it: some of our old methods have gotten dry and are not bringing in results. Even the U.S. Forest Service has retired Smokey the Bear. Why? Because they realized that adults in this country no longer take a talking bear seriously.

Someone remarked that a relationship is like a shark; it has to move forward constantly or it just dies. In terms of zoos' relationship with education and conservation, if we do not move ahead, I think what we will have on our hands is a dead shark.

Let us look now at an example of how a shift in the use of building funds can bring the broader picture of conservation more directly to the visitor. At Burnet Park Zoo there is a new exhibit area referred to as "Wild North." It was built with the objective of telling visitors about the balance of nature. The physical layout follows the sequence from Arctic to sub-alpine to deciduous forest to western grasslands. This allows the zoo to take visitors from an environment that has been least affected by humans to one that has been most affected. The entire master plan for the zoo totals \$12.4 million. The total expenditure for Wild North is approximately \$4 million. The zoo believes this is a significant expenditure toward educating the public about the big picture of conservation and is definitely an example of how a redirection of ideas and available funds can be used to address the issue at a zoological garden or aquarium.

But if you think generally we have truly made a dent in upgrading people's images of zoos, you only have to take off the rose-colored glasses for a quick look around to realize John Q. Public does not think zoos have a focus. Last month Newsweek magazine had an article on international terrorism and the media's problem with credible reporting The lead sentence was, "The idea of pool reporting was developed to make covering wars and presidents less of a zoo." If someone thinks using the word "zoo" as an adjective to describe an out-of-control chaotic situation is a compliment, we probably also have an individual who believes in the comeback of the Dodo.

However, there is a strong plus side to our institutions and it is the fact that zoos and aquariums have enormous integrative capacities. It is possible to have a synthesis of the two sides, the short term survival traits necessary for the zoo and the long term strategy which is critical for wildlife conservation.

To do this we have to keep asking ourselves, and then answering truthfully, how much of a shift have we actually made with a program. With each new budget there needs to be a hard look at the values, priorities and allocations to see if these reflect a new commitment to education conservation. I am not naive enough to think there is a zoo and aquarium in the world that has the resources to automatically make this shift without a hardship. But I am also not crazy enough to believe that some day all the money problems will go away and then we can do it.

The world is changing and we better, too. Sometimes this change has been so rapid I feel as bewildered as Dorothy when she suddenly found herself in the land of Oz and said to her dog, "Toto, I have the feeling we're not in Kansas anymore."

Unless we want to become a never-never land, living museums with no place to go, or even dead sharks, we have to keep moving forward. Most of us have a pretty good notion of the kind of world we would like to live in and it includes an abundance of wildlife and open spaces. Let's involve our zoos and aquariums in helping to nudge others in that direction.

WORKING FOR CONSERVATION EFFORTS

Edith Duckworth
Chicago Zoological Society

Let's start in 1978 and let's talk about a deficit--$5000 worth of it in a fund labeled "Conservation." Now let's jump to August, 1985 and talk about $50,000--$50,000 credit in that very same fund. Are you interested? I was vitally interested because I was the Chairman of the Committee that inherited that deficit. Happily, I'm still Chairman and my Committee also has the credit. I'd like to share with you how $5,000 worth of debt has become $50,000 worth of credit while at the same time over $140,000 has been dispersed into conservation projects.

In 1976 the Trustees of the Scientific and Education Committee of the Chicago Zoological Society, commonly known as Brookfield Zoo, granted a total of $4,700 for two research projects, one to be carried out in Australia and the other within the Zoo. The money for these grants came from a fund entitled "Research" which had received a few gifts over the years, part of which were believed to be restricted to endowment but certainly none of the Trustees knew that for certain or if so, how much. The Controller, of course, could have found out, but nobody on the Committee was asking him! Indeed no grants were again awarded by the Committee until 1979 when the reconstituted Scientific, Education, and Conservation Committee, usually referred to as SEACON, awarded seven grants totaling $14,750. What happened? Why the apparent resurgence of interest? Where did the money come from?

During the years 1977 and 1978, when the Trustees' interest seems to have been dormant, actually grand changes were taking place in the roles that they were assigning themselves for the Chicago Zoological Society. Board members who merely wished to lend a prestigious family name to the letterhead became an endangered species. Gone were the members who didn't wish to be bothered with actually coming out to the Park from their distant residences or downtown offices. And nearly extinct became anyone who didn't want to serve actively on a working committee. Strong leadership on the Board and strong encouragement from the Zoo's Director were the catalysts for such change. Each working committee of the Trustees then took up its own charge and its own challenge.

To the seven-member SEACON Committee, the course seemed ordained. It was sad to note that very few of our institutions had set aside specific funds for the conservation of those species whose very survival is the core of our institutional mission. Worthwhile projects continued to come to the Committee's attention from time to time both from Brookfield Zoo's own staff and outside researchers. It became increasingly difficult to accept that so many good projects would go undone, that so much knowledge would remain ungained, and that so many talents would not be utilized, all for the lack of dollars or, even worse, because of the Trustees' own lack of vision. If members of the zoo community did not take up the challenge, who else was there to do the job? Who else would be concerned with increasing knowledge, deterring destruction, preserving ecosystems, and banishing the ignorance that might eventually lead to the death of an entire species?

But what would happen if it were generally known that SEACON had entered the grant business? Would the Committee be inundated with requests both worthwhile and worthless and at a dollar amount far beyond its potential resources? Obviously parameters had to be established. Because of what would undoubtedly be limited resources, the Committee initially focused on two areas: seed grants, that is, the funding of projects that once underway with a demonstrable data base had the potential to attract money from large granting institutions; and small-dollar projects, where the SEACON grant could fund a study completely or provide the final dollars so that the researcher could complete his task. Eventually a complete set of priorities was established to guide the Committee in its allocation of funds. These priorities are concerned with work by Brookfield Zoo's own staff, research done by outsiders, the relevancy of a researcher's project to Brookfield Zoo's own collection or exhibition, conservation activities in exhibition, species-specific programs, national and international zoo cooperative and collaborative programs--just to name a few. While these guidelines and priorities are ever evolving, they provide a focus for evaluation of the researcher's formal, written request.

When the members of SEACON embarked on the grant program, they knew that the money issue would be paramount. What they did not realize is that an untapped audience exists for conservation matters. People who will not give a dollar for bricks and boards will join conservation efforts; other people, already contributors, will give additional funds for such programs; and finally other members of the Board of Trustees would come to deem these grants of such importance that they would vote to allocate 10% of the annual general appeal for SEACON's use and themselves support SEACON's conservation efforts with contributions and skillful investment of uncommitted funds to maximize SEACON's dollars. Solicitation of the general membership of the Chicago Zoological Society is planned in the near future. A simple check-off box on the membership renewal form will encourage members to add $10, $25 or whatever amount they wish to their membership fee to be used exclusively for conservation efforts.

Awareness of the Chicago Zoological Society's conservation programs and donor generosity have allowed SEACON to fund at growing levels. In 1983, fifteen grants were funded for a total of $42,850; in 1984, fourteen grants totaling $30,750; and thus far for the first half of 1985, ten grants have been funded totaling $26,625. The grants have ranged in size from $480 to $13,390; projects have involved animals as small as mice and as large as dolphins; ecological investigations have included studies from single grasses to complete ecosystems. Work has been done on six of the seven continents.

There has already been a substantial return on investment. While it is difficult to put a dollar value on knowledge gained, information disseminated, experience broadened, mistakes avoided, or lives saved through the various research projects, it is gratifying to report that in one instance a group of researchers who began with only their own funds and seed money from SEACON subsequently attracted more than $100,000 in foundation monies, university aid, and foreign government sponsorship for their continuing work. SEACON's awards to this group over a three-year period amounted to less than 10% of the final funding of their studies. And therein lies the lesson. What appears to be exceedingly small sums of money can do an enormous job because other, finite resources are being attracted to the conservation cause. As the Chicago Zoological Society's conservation story shows, what one group of Trustees has started can be of some small significance. What many groups can do can be of great significance. The Trustees' challenge in the future is this: to make a difference, to reach out from our home bases, to invite world participation in the zoo community, and to raise the dollars necessary to transform the vision of what should be to what is.

TRUSTEES: WORKING WITHIN THE PUBLIC AND PRIVATE SECTORS

Lawrence W. Johnson, Chairman
Riverbanks Zoological Commission

Every existing accredited facility has a different origin. We have each blazed new trails to achieve our present status. At Riverbanks Zoo and Park, Columbia, S.C, we have studied, examined, and reached out for assistance to the pioneers in zoos and parks to formulate our organization, define our policies, and identify our objectives.

The committee of volunteers I chaired at our Chamber of Commerce in 1960, traveled to numerous zoos all over the country. We sought assistance of business, commerce, and industry to volunteer bricks, mortar, and engineering toward the beginning of our facility. Site selection proved our first major road block. We consulted professionals and chose Marlin Perkins then Director of Lincoln Park Zoo to visit our potential sites: an industrial area, a center of residential development, an undeveloped area at the confluence of two rivers near the heart of the city.

We appeared before political groups, House and Senate members, and City Council, all of whom had indicated token financial support. Community support had to be nurtured in a city of 100,000, with only a limited number supportive of the concept; others adamant over the prospect of increasing taxes to support a zoo, and many fearful of devaluation of their property if located near them. Public hearings to inform all citizens of our project met with mixed reaction, limited support, angry denial, and requests for greater detail. The more hearings we held the larger the crowd and more expressive the citizens became.

The site committee, under the direction of Marlin Perkins, finally chose the river front and recommended negotiations with the owner of the property, a public utility. That decision with a utility that had been at the center of progressive and dynamic changes in our city made our job easier. They agreed to lease 11 acres immediately and subsequently a total of 100 acres on both sides of the river for one dollar a year on a 99 year lease. We could'nt refuse their generosity.

The availability of a larger land mass caused the now united community to think in terms of a larger complex. Legislators from the two counties in which the land was located, introduced legislation creating the Riverbanks Park Commission, consisting of seven members to be appointed by the political bodies. The Commission was given broad ownership and investment powers, responsible for management of the park, and provision for bonded indebtedness for development. The legislation defined our mission: To develop a facility that would provide a habitat for endangered species; enable our children to have "hands on" experiences with all of nature and to provide wholesome family recreation.

Our objectives were now transformed from a small facility with a story book theme and indigenous animals to a zoo that would be the pride of present and future generations. Our priority was to ensure a quality exhibit at minimum cost. We began to advertise for a director to assist us in planning, architectural design, a management team, and assist in day to day consultations with architects, engineers, and zoo planners. Everything began to fall in place. The political bodies with which we had maintained a close liaison enthusiastically supported a six million dollars bond issue. We were off and running. Don't misunderstand my enthusiasm, we had the usual complications in construction: cost overruns, revisions in structures resulting from inadequate site planning, concerns over stocking the park; yet we opened to the public in 1974. We also experienced management interruptions with the loss of our director. Once again we sought the counsel of professionals and Dr. Charles Schroeder, retired director of San Diego Zoo, was chosen as our interim director and consultant. He reviewed applications for a new director; developed a table of organization; conformed personnel responsiblities, and assisted in refining our Society. Additionally, we associated our own Bob Wagner to to review the 22 applications we had on file and finally we all agreed that one of our staff members, our general curator, was the top choice. He is known to many of you - Satch Krantz. He has proven to be a real professional, an able administrator, and a good communicator of zoo philosophy to the community and the commission.

A word to all of trustees, commissioners about our leadership, especially your director. He needs our support, encouragement, and assistance. Keep your lines of communication open - be a good listener. Have times of sharing together your ideas, thoughts and emotions - he has no one else to turn to. Ideas generated in your private consultations can become the chemistry for new promotions and revised objectives that can move your zoo into unparalleled achievements.

A word of caution - don't extend yourself into daily operations. The director and the management team have that responsibility and "the buck stops there." Commissioners, trustees, directors, let your posture be a positive statement of approval to your management team and confine your energies and emotions to the public and private sectors for financial and political support and encouragement of every phase of your operation.

Throughout our short ten year operating history we've had need for financial support beyond that we receive from political bodies. We found response to our appeal from fund raising efforts among school children, and substantial support from the sororities and fraternities on the campus of University of South Carolina that raised an average of $25,000 annually in five successive years. Additionally, in 1980 we successfully raised $600,000 in a public fund raising compaign for an educational building that today is an education center for children and a center for seminars by many businesses and industries.

To you that are funded totally by a state, municipality, or trust funds, my hat is off to you. In South Carolina, we tap every available source and frequently feel like a puppeteer trying to coordinate our resources.

We (Commissioners) are lobbyists in the unofficial sense and maintain close contact with S. C. Senators and Representatives to encourage visits and to solicit support. During the legislative year just ended 30 June, we were successful in increasing our State funding 100% to $200,000. Likewise, our Representatives and Senators in Washington are kept informed on a first-name basis and they feel a particular pride when they award I.M.S. Grants.

In South Carolina we are aggressive in all political arenas - City, County, and State, to ensure that all are informed and alert to our needs. We maintain a close liaison with County Council members; are attentive to their suggestions for strengthening operations, and encourage their visits to our facility. Currently, we have before Council a request for a 6.3 million dollar tax supported bond issue for capital improvements to expand and improve Riverbanks Zoo. We plan an addition of an aquarium and a reptile house to increase public awareness and effect greater efficiency designed toward improving our financial self sufficiency.

Ours is a "people business" and we have been most fortunate in developing a support throughout our State, through our Riverbanks Society with a membership of 13,000 members, representing 36,000 people. We are also alert to our fundamental appeal to tourism. We are aware of the contribution that 400,000+ visitors annually make to our local and state economy.

We do pay attention to our homework. We support our management team and encourage their enthusiastic and objective approach to every phase of our operation.

We require an aggressive public relations program - "We've a story to tell." Our professional public relations coordinator never misses an opportunity for press releases or special events. Our staff is constantly on the road to civic clubs, social groups, or participating in community programs. We have unparalleled support from the media - radio, television, newspapers.

We require continuing maintenance of buildings and grounds; basically it's a park and our visitors applaud its appearance. We continue to provide adequate funding through reserves to maintain the standards we have set.

We require sound fiscal and monetary policies. Budgeting is the core of our operation, tied to an outside audit by CPA's and a management letter keeps the public bodies we report to informed and appreciative.

We encourage a continuing review of our personnel policies with compensation and related benefits competitive with our industry. Benefits keeping pace with our expanding market place ensures a staff that enthusiastically contributes to our growth and success.

We support change, not for the sake of change itself, but to encourage increased attendance; to maintain enthusiasm and creativity among the staff, and to decrease support funding. Change can be accomplished through orderly and objective planning, both short term and long term.

A few words about our future - not only our facility, but our entire industry: We must prepare for major changes in the 1990's, primarily because of tremendous changes in attitudes on the part of the visitor. We will be rethinking what we are, what we do, and who we are - particularly as it relates to working together in the public-private sector. Planning short range, long range will be a requirement, measuring results periodically a must, and flexibility to respond to the demands of the tax paying public, a necessity.

Two texts that have caused me to re-evaluate our position are: John Naisbitt's book "Megatrends" and Tom Peters' book "In Search of Excellence." Naisbitt wrote, "Trends are like horses, they're easier to ride in the direction they are going." It has always been my impression that successful leaders could effect change and make people turn around from the direction they were heading. This is not possible in our industry. The trend is so intense, the change that has already occurred is so great that unless we get out "in front of the parade" we will be like the caboose that has been eliminated from the train.

We need only to reflect on the changes that occurred when our country moved from an agricultural society to an industrial based society early in this century. Today, only three percent of the work force is still in agriculture. We have already entered an information based society and are being moved rapidly forward by advanced computer and communications technology.

Naisbitt leads us into another phase of our advancement, "High Tech and High Touch." Unfortunately, it is de-humanizing; all of us become a number and could easily alienate us from the public, that is a source of livelihood. Couple "high tech" with deregulation in almost every segment of commerce and industry, together with decentralization, and you have transferred high tech to the hamlets of this country. Consider the impact of G.M.A.C. in bringing High Tech, High Touch" and 26,000 people to a town of 1500 in Spring Hill, Tennessee in the manufacture of their Saturn automobile.

Another trend Naisbitt tells us is from a representative democracy to a participating democracy. Today, people want to be a part of the decision making process - that we may have left previously with politicians in the public sector. Proposition Thirteen was a recent example. In our community, a group of tax payers tried to negate the decision of County Council that had approved a tax supported bond issue for a Performing Arts Center. We must become more aggressive in involving our citizens at every level of our operation.

I share with you a quote that I believe may represent the opportunity we have before us. Henry David Thoreau said, "If one advances confidently in the direction of his own dreams, and endeavors to live the life which he had imagined, he will meet with success unexpected in common hours."

Naisbitt, John, Megatrends
Peters, Tom, In Search of Excellence
Thoreau, Henry David - Walden

Good Trustees and Good Staff: A Winning Situation

Penny J. Korhumel

The speakers have expressed the concern and dedication of a very important group of people: those who give their time voluntarily to serve the numerous non-profit institutions in our country. How important are these trustee-volunteers? How valuable can they be as resources for our zoos and aquariums? The answer to that question will vary depending upon the willingness of each individual to be involved and the effective management of this interest.

Today we have heard from very involved trustees about ways to recruit trustee leadership as well as ways to put trustees to work in the field of conservation, policy making and development.

One other extremely important aspect of the role of a trustee must be emphasized at this point: the task of fund-raising in the private sector. All of you are aware of the ever growing need for dollars for capital expansion and the correspondent shrinking resources available from the public sector. Good trustees must be prepared to dig deeply into their own pockets to set the proper example for others to whom they will subsequently go for funds for their organization.

On another matter, when this session was announced, I was approached by the program committee to discuss the matter trustee's interfering in internal affairs. The committee also asked me to discuss how to raise the level of knowledgeable involvement on the part of the trustees. Reflecting on these different concerns, it became apparent that the solution to both problems lay largely in the hands of those who recruit these individuals to serve.

Sound planning, a need which exists in all areas of our operations, is also vital in order to achieve optimal trustee-staff communication which will result in subsequently effective trustee involvement.

As in any relationship, the ground rules need to be established so that the players understand what they can and can't do and what the goal is. It is not productive for staff and trustees to ascribe blame for their periodic wrong relations with each other.

The tremendous challenges which face us all in the future will be discussed throughout the week. Such concerns as finance, animal welfare, conservation, planning and education will be addressed. I have been told by a number of our most distinguished zoo and aquarium professionals that many of the animals that are entrusted to our care will not exist in the year 2000. For volunteer leaders and zoo staff there is clearly a challenge ahead. The formula for winning in this situation is to have good staff and good trustees understanding their jobs and proceeding to get them done.

The fate of the tropics: are things as bad as they seem; and, if so, what can be done?

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"Development progress is currently threatened by adverse international economic conditions, natural disasters, and imprudent policy choices." (Sewell, 1985)

Introduction

A recent study by a Smithsonian entomologist has recently dramatically revised our estimates of the number of animal species now present on Earth. This study provides data which enormously accentuate the degree of species loss that will occur if the tropical rainforests are destroyed. Erwin (1982), collecting insects from the canopy of tropical forest by a novel technique, estimates that the number of insect species now alive may be from 15 to 30 million. At one stroke he has raised the potential number of extinctions that would follow the destruction of the world's rainforests fifteen to thirty times from what was once estimated (more than 99% of all animal species may be insects).

Some biologists have been claiming for some time that the rainforests are doomed and will disappear in a century or less (Myers, 1985, for example). The data are by no means straightforward and many calculations are indirect and involve unproved (but not necessarily unfounded) assumptions. There are discrepancies between current estimates of forest loss. The study of Myers (1980) for the National Academy of Sciences, predicts a loss rate higher than that calculated by Lanly (1982) for FAO/UNEP. This latter study is based, in part, on the use of satellite imagery (for 13 of the 76 countries studied). Despite discrepancies (see Melillo, et al, 1985, for analysis of the reasons for the differences) forest losses are alarming: for closed tropical broad-leaved forest, at least 5.9 million hectares per year (FAO) or as much as 7.5 million hectares (NAS). To this must be added figures for the degredation rather than the destruction of forest.

Figures like this are difficult to visualise in real terms and perhaps less meaningful than percentage figures. A sampling of percentage figures certainly strengthens the impression of massive forest losses. In Burma, for instance, one of the countries for which the FAO study used satellite imagery for analysis, the picture is dramatic. The official figure for forest cover is 57% (probably a 1970 estimate). In 1975 there was really only 47% cover, and in 1980 43% cover. By now the forest is probably reduced to 37% (Blower, 1985). The government still quotes a figure of 57%. In nearby peninsular Malaysia forest cover has declined from 84% in 1958, to 65% in 1971, dropping to 55% in 1976 and an estimated 49% in 1983 (Aiken & Leigh, 1985). Figures for some African countries and Latin America are equally forbidding. Forests in the Ivory Coast have been reduced by more than 65% in 25 years. In Costa Rica there has been a more than 30% reduction in ten years, and a reduction of 40% between 1961 and 1978 (Corson, 1985).

The forces of destruction

The forces at work in this process of destruction are relatively simple. Forest destruction results from the efforts of indigenous poor impelled by need; and national and international corporations impelled by the search for profit. The poor destroy forest for land and fuelwood, the corporations (and governments) for commodities such as timber and pulpwood, as well as for land to be used for commodity production (export crops and meat). There are some arguments about the relative effect of these various factors in the destruction equation (Robinson, in press) but there is general agreement that these are the causal factors.

How can the destruction be halted?

The extent to which destructive forces can be controlled, and the extent to which the destruction can be halted, are debatable issues. For instance, it can be argued that food needs can in most countries be satisfied by the efficient utilization of already cleared land (Lappe and Collins, 1977). But there are formidable political and social obstacles to this solution even if it is a real one. Hodder, (1980) pinpoints one such obstacle: "it is always a temptation, where circumstances allow, for increases in agricultural production to be sought by expanding the area of land farmed rather than by intensification through changes in agricultural systems or by the application of better agronomic practices". And of course this view ignores the point that landless peasants do not have these options, their only option is to colonize new land.

In Africa a picture emerges of countries with economies stretched to breaking point with continually depreciating export commodities on the one hand and constantly increasing import costs on the other (Timberlake, 1985). Such countries are impelled to fight their mounting debts by exploiting more and more of their natural resources and constantly trying to produce more land for commodity crops. The pressures on tropical forests thus seem inexorable, and the solutions to economic problems scarcely conceivable. The recent drought in the Sahel may simply highlight conditions that are a symptom of a more widespread non-climatic disease. The destruction of an important element of our environment is probably not just a global environmental problem but the reflexion of global social and economic problems. Be that as it may we can say with a high degree of certainty that the way to exploit tropical forests is not to turn them into low yield pastures or agricultural land. It may also be true that the best way to exploit the forest land is not to replace indigenous multi-species forests with pure stands of exotic softwoods. But we do not really know how to use these forests for the benefit of mankind.

More than anything we need time to study the biology of tropical forests and their components. We need to stop the destruction and invest in research. This is not merely because we are threatened with one of the most dramatic periods of extinction in the whole history of life on earth. It is also because the destruction of the rainforests is likely to be an unparalleled disaster for the peoples of the rainforest countries. The social disruption, shortages and economic chaos that could result are probably incalculable. How can we buy time for the research and how can it be mounted and financed?

In my view there is no possibility that the developing nations can fund a moratorium on forest clearance. They need the hard currency from the lumber and the products from the cleared land. The only answer is some kind of subsidy from the developed nations. Since the problem is a global one, some kind of levy on high income nations, on a per capita basis, would be feasible - an OPEC style arrangement. This has been suggested in a very careful analysis by Rubinoff (1982). On the other hand a levy on those nations that import large quantities of commodities, particularly forest products, from the Third World might be more equitable. Either way this would be a subsidy to reward nations for the preservation of forests. It would provide purchasing power to buy hard currency imports. It could help absorb North Temperate food surpluses to feed the South.

The role of zoos

The real problem is that although a variety of suggestions have been made about a moratorium there has been no action. No government has ever reprinted any of the proposals (that of Rubinoff is certainly sufficiently well argued to merit distribution to decision makers). In the absence of action I think that we need a campaign to bring public opinion to bear, or at the very least create a lobbying movement. I think that zoos could have an inordinate influence, for good, in developing public pressures for conservation. Large numbers of people visit zoos, in part at least because they are interested in animals. Their interest in animals may be emotional as well as rational but it can be translated into concern. If we cannot translate it into concern then we are not exerting ourselves adequately to take advantage of the ambience that our zoos create. We have to give great prominance to the message that the beautiful and exciting animals that are in zoos today will not be there tomorrow unless we save habitats as well as species.

All this does not mean that zoos cannot play a direct role, as arks, in saving species. Of course they can and AAZPA in promoting SSPs is playing a pivotal role in this important process. Zoos should also consider using their climate-controlled facilities for propagating endangered plants as well as animals. The extra burden of husbandry would not be too debilitating. The exclusivity of interest in animals alone is already breaking down as we make exhibits more natural by including plants. These are important trends but when we consider the millions of species of invertebrates SSPs are put in a true biological context. They are noble and important efforts, they can preserve jewels and masterpieces but we must strive to save the wealth of evolution.

Signs of hope from the research front

The search for non-destructive methods of exploiting tropical forests for the benefit of tropical man is not hopeless. There are some promising leads. Throughout the forest zone their are indigenous peoples that have evolved a productively harmonious relationship with the forest. In Mexico, the Lacandon Amerindians, practise a form of agroforestry that may date back to Mayan times (Rich, 1982). This involves multi-species cropping of plots within the tropical forest. Up to eighty plant species may be cultivated; maize yields are higher than those produced in the same area by recent imigrants and no artificial fertilizers, insecticides or herbicides are involved (Caufield, 1985, Rich 1982). Such systems which may be more widespread than is realised. My own experience in Papua New Guinea suggests that forest gardening there, in its original form, is more ecologically sound than farming in Panama, where I lived for many years.

Another possibility is that biologists can contribute to new techniques from their studies of animal and plant ecology. Biologists at the Smithsonian Tropical Research Institute, in Panama, developed a program of research into "Alternatives to destruction". This involved investigating systems for the propagation, husbandry and domestication of forest animals (as eventual foodsources) and studies of systems of within-forest agriculture (Robinson, in press). The National Academy of Sciences has a Board of Science and Technology for International Development (BOSTID) which publishes very useful reports on underutilized species of plants and animals. The BOSTID report describes an interesting variety of wild cattle and pigs that could be studied for possible domestication. Zoos could perhaps play an important role in such studies.

These are but a few suggestive examples of some applied research prospects. Tropical scientists can say "give us the money and we can provide the insights, experience and enthusiasm". We should be supporting them in every way possible, with encouragement and with action to arouse public opinion.

Postscript

There is another more fundamental area for study that needs urgent attention: reforestation studies. Northern foresters have studied how to grow a wide range of tree species in the tropics but nobody has studied how to recreate on cleared ground, species-rich tropical moist forest. This may have over 150 species per hectare. At present the best estimates suggest that it takes hundreds of years to reach its climax form if it passes through natural succession. There may be some way to eliminate the successional stages. If the recipe for recreating tropical forest were develoepd, knowledge would be on hand for the day when some wise government says, "Here once was magnificent forest; put it back!"

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POPULATION MANAGEMENT FOR BIRDS: A GROWING NEED

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Estimates of the number of animal species now in the world vary according to the prejudices of each taxonomist consulted. Nowak and Paradiso (1983) in their revision of Walker's Mammals of the World, list 4,153 species of mammals. Peters' Checklist of Birds of the World (1979) lists 8,805 bird species and Moroni, Bock and Farrand (1975) 9,012 -- roughly twice the number of mammal species. In a recent paper, Conway (1984) estimated the species carrying capacity of the world's zoos. Using data on the number of individuals now in captivity, the total zoo acreage available and an average number of animals necessary for long term population management, he calculated that, optimistically, about 330 mammal and 467 bird species can be protected over the long term. This is less than 10% of mammal species, about 5% of birds.

Even though these numbers are small compared to the total number of species which may need help, the work has hardly begun. The studbook is one of the basic tools of species management and we may use the number of active studbooks as an index of what has been accomplished to date. The 1984 edition of the International Zoo Yearbook lists 61 studbooks, 52 for mammals and 8 for birds. It is noteworthy that while there are twice as many bird species as mammal species, there are six and a half times as many mammal studbooks as bird studbooks.

A brief glance at the avicultural literature will convince anyone that there is a long and proud tradition of breeding captive birds. A brief glance at bird curators across the nation will convince anyone that bird curators are not prone to modestly hide their achievements. Why then are both the absolute and relative numbers of bird studbooks and bird management plans so small compared to those for mammals?

The first answer is simplistic. Studbooks have a long tradition in commercial mammal breeding -- dogs, cats, horses and cows have often had their values defined by their ancestry or pedigree. The term studbook is defined by the Oxford English Dictionary (1973) as "a book giving the pedigree of thoroughbred horses; also a similar book for dogs, etc." Its use has been expanded, so that it now refers to a listing of any group of animals and their offspring.

Second is the relationship between zoo censuses and patterns of extinction. In the last few decades, many of the most popular mammal species in zoo collections have become rare in the wild and breeding programs were developed for them in zoos. This has been much less the case for birds. While many bird species have become endangered, few of these were well represented in zoo collections and none had the public appeal of tigers and rhinos. Cranes and condors probably wouldn't make it on a visitor poll of "ten most popular species."

Studbooks, then, have been both natural and of practical necessity for people working with mammals. To aviculturists, interest in studbooks has been more theoretical.

The development of regional and international studbooks and increasing cooperation among zoos have made cooperative management of captive populations a possibility. An ever increasing rate of extinctions has made it a necessity. These forces were behind the development of the Species Survival Plan (SSP) concept and its implementation. The program has generated tremendous enthusiasm and has already become a potent force for conservation. One might have expected its momentum to increase the attention paid to programs for bird management, and indeed it has. However, the AAZPA lists 30 mammal studbooks and 8 for birds; the SSP has 25 mammal programs and 2 for birds.

Two SSP-related factors may actually be inhibiting the development of management schemes for birds. The first is one that I have become aware of through conversations with a number of zoo people. It is the distinct perception that participation in an SSP program requires an advanced knowledge of both genetics and computer science, as well as other miscellaneous and arcane lore. That this is not the case has no effect on the impact of that myth.

The second factor lies in the realm of not "seeing the trees for the forest." To be designated for an SSP, a species must have a captive population sufficient for management, must be endangered in the wild and must be a subject of sufficient interest to enough zoo professionals for management plans to be developed and executed. What many have lost sight of is that it is not necessary to meet all SSP criteria to propose a studbook -- indeed, a studbook should be in operation before an SSP is proposed. The SSP represents a serious and permanent commitment to long term management, but there is still a great deal that can be done towards managing species and developing breeding programs at the pre-SSP level. The attitude that "we should do nothing if we can't do an SSP" is a mistake, especially for those of us working with birds.

It is my personal conviction that we need more management of bird species now in collections. Rather than develop some parallel or renegade alternate format, these plans should be based on AAZPA recognized studbooks.

Of the 9,000 bird species, perhaps 9% have been bred in captivity (Conway, 1984), few predictably and regularly. How censuses are determined in the 1980's depends largely on the intersection between the group of species we can maintain relatively easily and what is available from dealers and other zoos. The 30-day quarantine requirement has greatly reduced the probability that species we are unfamiliar with will be imported. It is very likely that the next two decades will see increasing restrictions on imports of birds, whether because of local or international legislation, politics or difficulty of obtaining specific animals. Even now, it is one thing to see a bird you want on an importer's list, quite another to obtain even a common species if it doesn't happen to be listed. New species are thus likely to be ones for which special efforts must be made because they have become endangered, like the birds of Guam.

It is unlikely that we can or will devote all our space to such animals, if only because of the need to please as well as educate the public. It is highly likely, therefore, that many of the species we will be managing in the year 2000 are already in our collections. We should look closely at species we are maintaining now, with this in mind. For many species we will never have a better founder stock than we do now.

If we were suddenly to discover that the species now in our care were all endangered, we would be hard put to meet the challenge of sustaining them over a long period of time with our present knowledge of aviculture and management. In order for intelligent decisions to be made concerning population management, focus on single species with some form of studbook is necessary. Only then will we be able to identify what areas of aviculture require the most attention. Some species, we will find, breed readily from wild caught individuals. Others, perceived as commonly bred, are numerous only as the result of a few prolific individuals. In some species, wild caught individuals may be reluctant to breed, but captive reared individuals may breed reliably. Hand-rearing may inhibit or increase breeding success, depending on the species. Success with one species does not automatically imply success even with close relatives. We have truly identified the factors involved in breeding birds on purpose for only a few species and can generalize those factors to only a very few useful principles. To get a grip on what we need to do, we need the information provided by studbooks.

If we fail to act now, popular species commonly bred, like the lilac-breasted roller and the red-crested touraco, will start the same cycles of boom and bottleneck so bemoaned in the tiger population. Because these birds are commonly bred they have a relatively low market value and are not frequently imported. Already it can be difficult to sell domestically reared youngsters of quite a few species. The argument that we need not manage those species that are still available in commerce fails here. Almost anything we breed successfully will become less attractive to importers unless a strong demand for new blood develops. Influx of new blood is further inhibited as a corrolary of an ethic that we have worked hard to develop, that we should obtain captive reared birds when possible, so as not to consume wildlife. Studbooks, will help pinpoint the need for new founders while they may still be available. If we wait to manage these species until we lose them we may find that they are no longer available for import.

If it is probable that a species we are breeding now will be part of our long term census, why not establish it now? Why spurn the red-crested or white-cheeked touraco because we can breed it, in favor of touraco species we cannot obtain? If we want a touraco to exhibit over the long term, and I believe we do, now is our chance to manage that population, before there is a problem. At worst we learn the art of management and hone our skills of husbandry for cases when we must quickly develop new breeding programs. I would far rather see us forced to suspend or even abandon studbooks because new species have higher priorities than have us wait to learn complex tasks until it is too late to practice.

Currently, avicultural achievements are mostly general and qualitative. Most of the time none of us can state precisely why we succeed with some species, much less why we fail with others. The development of large natural habitat aviaries in the '60's and '70's resulted in the breeding of many species never bred before. It also caused, at least temporarily, a feeling of complacency: that all our problems had been solved. This attitude is still commonly held by the public and by many zoo people not directly involved with bird management.

In fact there is a growing feeling among aviculturists that, while such habitats are excellent for public education, they can be, adjuncts, at best, to a serious breeding program. Natural habitats are costly, requiring much space and much time to maintain. They can usually support only one pair of species which do not breed colonially and then encourage us to keep some birds in social situations which do not promote breeding. For example, how many exhibits have we seen of large numbers of tanagers in mixed flocks and how many tanagers do we know of which breed like that? Worse, there are many species for which these aviaries are not at all suitable for breeding -- lek birds for example, where females normally do not nest in proximity to males. Bird breeding programs need both innovations in exhibit design and off exhibit space where multiple breeding pairs can be maintained and controlled experiments in husbandry can be performed. All of these things will evolve naturally if we begin directed and coordinated breeding programs.

One cause for concern and a possible reason for holding off on new studbooks is the limited number of people available to physically undertake them. This objection does not seem reasonable at this time, for several reasons. The biggest and most intensive chunk of work usually comes early in the history of a studbook. Within a few years, whether on index cards or computer, the workload involves only updating and maintenance. Most of the ambitious young folk, ready to tackle putting a studbook together now, may be lucky if their workloads allow time for studbook maintenance in 5 or 10 years. Jobs and people evolve and the people ready now may not be available later. Right now, managing a studbook makes one part of an elite. To become widely used tools, studbooks must become demystified to the point where a majority of the zoo community can participate at one level or another. Each person involved now will undergo a learning process and be able to encourage and teach several of the next generation. As studbooks are standardized, it will become easier to turn routine updating tasks over to less skilled personnel. Eventually one experienced person might be able to handle several studbooks.

Studbooks, as a rule, have more in common than not. It seems reasonable to expect that the work required to organize and direct a studbook may decrease in the future, as people working now solve the problems common to all. The same holds true for management plans. ISIS, in particular, has the potential for taking over much of the grunt work. There has traditionally been an uneasy relationship between ISIS and the bird community. The active development of studbooks could be the factor that removes that uneasiness. As more bird collections become involved in cooperative management, ISIS will become more and more useful in eliminating duplication of effort on the part of participants.

It seems to me that we have two courses open to us in relation to management of our bird collections. The passive course dictates that we wait for species to be in trouble before addressing their problems. This gives us little choice in what the bird collections of the future will look like. It gives us little chance to work out breeding and management techniques before tackling endangered species, to say nothing of working out habits of cooperation among zoos. (We may all have to someday send a favorite animal to some institution we cannot personally abide.) It also leaves the current generation of bird people in limbo.

The active course would have us looking critically at our collections, evaluating our past successes and failures and developing long term plans for some of the species we now maintain. We have a chance to dramatically improve our odds of rescuing future endangered species by improving our skills now. We must advance the status of aviculture from mysterious art to teachable craft, from alchemy to science. Already experience with kookaburra and red and white rails has prepared us for work with Guam kingfishers and Guam rails. We could not do the same for a grebe, a tanager, a hummingbird or a hornbill. It will take a long time for the machinery of studbooks and cooperative management to become second nature to us all. We cannot afford to wait until a tool is necessary to learn its use.

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The AAZPA Clearinghouse

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Four years of intensive discussions, proposals and counterproposals between officers of AAZPA and USDI resulted in the signing of the Memorandum Of Understanding or MOU by both parties in October of 1984.

Prior to the actual development of the MOU, USDI had been unable or were reluctant to enforce various wildlife laws and/or confiscate illegally imported wildlife due to several factors; those were, USDI had no storage or holding facilities for live animals nor the personnel to care for live animals, financial reimbursement to holding institutions was difficult due to the lack of appropriate funding within USDI, transportation to and from holding institutions was likewise hindered due to these financial restraints, prosecution and final resolve of pending cases frequently required long periods of time, thus resulting in an understandable lack of commitment of institutions willing to accept confiscated wildlife and USDI lacked the information and cooperation necessary to place confiscated wildlife in institutions capable of providing proper care. Ready solutions to these and other associated problems were not readily apparent and required several years to address. Once these problematic areas were addressed and compatible solutions offered, the AAZPA Board of Directors approved the signing of the MOU.

One stipulation for the implementation of the MOU was that AAZPA establish a "Clearinghouse". The Clearinghouse would serve as the initial contact between the two organizations, identify AAZPA institutions willing to hold the seized wildlife, assist in the establishment and maintenance of the legal paper trail and other data necessary for long term specimen identification and facilitate the shipment of wildlife to participating institutions.

Several individuals had been involved in the development of the clearinghouse concept for over two years. During that period, a questionnaire was developed that asked what individual groups of animals and in what numbers those animals could be held by a participating member institution. This questionnaire was mailed with a detailed cover letter and an SSP type memorandum of participation (MOP) to each AAZPA institution. The MOP, when signed, indicated the institutions willingness to participate in the program and designated an institutional contact. A total of 109 responses were received. Of that total, seven were from institutions that for a variety of reasons declined participation. Several of our Canadian and foreign colleagues agreed to participate but due tothe complications involving various statuates all were removed from the participatory list.

A Clearinghouse Committee was appointed in December of 1984. The MOU technically went into effect in January of 1985. As most wildlife confiscations will occur at U.S. Fish and Wildlife designated ports of entry, committee composition reflects those geographical sites. To facilitate implementation of the MOU, USDI conducted a meeting in

December of 1984. The purpose of that meeting was to inform all special agents in charge (SACS) of the contents of the MOU and how it would operate. Subsequent to that meeting, USDI provided AAZPA a current list of all SAC's and AAZPA provided a list of all committee members and advisors to USDI for distribution.

A computer program was then designed to assist in the development of the actual Clearinghouse program. This program would be the actual means whereby confiscated wildlife would be evenly distributed to all participating institutions. All data obtained from the questionnaire was broken out into thirty-seven separate animal catagories. After considerable discussion, it was agreed that all institutions would be arranged on a rotational basis for each category. The order of rotation was based upon the institutions ISIS number and thus roughly represents an alphabetical listing. Although this arrangement favors certain institutions initially, thru usage of the system all institutions will have an equal chance to receive wildlife and the rotation list will become random. This has proved to be the case. Several other methods concerning the development of the rotation list were discussed. It was felt that the resultant confusion and difficulties involved in the explanations to participants made these methods unacceptable.

The Clearinghouse is arranged to function as follows; when USDI determines that a confiscation will occur, the SAC will contact either the committee member at the appropriate port of entry or the Chair of the Clearinghouse. The committee member if so contacted then notifies the Chair of the pending confiscation. Generally at this juncture, the date of the confiscation, the specie or species to be confiscated and the number of specimens involved along with other pertinent information is provided. This has not always been the case.

Several confiscations have occurred with little or no notice to anyone connected with AAZPA. Additionally, on two occasions individuals not fully informed reverted to pre MOU disposal methods. Again, on three occasions after a confiscation had occurred and institutional placement secured, the specimens were required for other USDI related purposes and thus not available to the receiving institutions. In all instances the institutions involved have been most cooperative and understanding and the situation resolved to the apparent satisfaction of all.

Once the Clearinghouse is notified of a pending confiscation, the Chair contacts the committee advisors, provides them with all pertinent information concerning the pending confiscation and all other relevant data he feels will influence AAZPA's decision to become involved. This data includes: space available, desirability of the species involved, numbers of specimens involved, and the apparent willingness of participating institutions to accept or hold the species involved. If the decision is to accept the involved wildlife, the Chair then notifies the committee member of the decision. The committee member then informs the SAC of the decision. Together they complete arrangements for the actual transfer of specimens once the confiscation has occurred. Included in these arrangements are all the necessary documents to either release the wildlife to the holding institutions or begin the paper trail to trace the specimens until legal settlement is achieved. If it was determined that AAZPA would not accept the wildlife, both the SAC and the committee member are notified of this decision. AAZPA is then no longer involved in the case.

At this point, the Chair refers to the catagories list to determine institutional rotation. The first ten institutions appearing on the category rotation list will be contacted in order. If willing, they will receive all or part of the seized shipment. If not interested, this will be indicated. In either case the institutions will then be assigned to the bottom of the rotation list and all other participants will automatically move up. Provisions are included to indicate if and when an institution either accepts or declines a shipment. If declined, a general category of refusal is indicated. If accepted, the number, species, date received and all other pertinent data will be recorded for record keeping purposes. Likewise if an entire shipment is rejected by AAZPA that will be recorded for future reference and use. A master list of all Clearinghouse MOP signatories, contact individuals and phone numbers has been prepared and distributed to all Clearinghouse members.

Generally a minimum of ten institutional contacts are required to successfully place an average shipment. Smaller shipments have been dispersed in one to three contacts, while larger shipments have required twenty to twenty-five contacts. An institutional contact represents two to three phone calls between the Chair and the institutional representative. Placement of an average (twenty to forty specimens) will require eight to twelve hours of elapsed phone time.

Once the receiving institutions have been identified, this information is then provided to the committee member. The committee member then begins to make arrangements for shipment to the receiving or holding institution.

The system has been in operation for over eight months. During that time the Clearinghouse has handled or been involved in 29 cases. Of those 29 cases, 18 (62%) resulted in confiscated wildlife being placed in participating institutions. Six cases (20.5%) were not accepted by AAZPA and five cases (17%) were confiscated, but due to a variety of reasons, AAZPA failed to receive the confiscated specimens. Twenty-six different species were involved in the 18 confiscations involving placement. An additional 12 species were involved in the cases where AAZPA was not represented in the final settlement.

A total of 1,492 specimens of 26 species have been successfully distributed to 38 different participating institutions. This represents 51.6% of all participating institutions. Several institutions, due to their location on the rotational list have received specimens from more than one case. The 1,492 specimens are represented as follows: mammals (1), birds (112), reptiles (679), and fish (700). A total of 7 species and 57 specimens were offered, and in most instances, placed by the Clearinghouse, but were never actually received by the Clearinghouse for distribution. Three factors were the reasons behind these decisions; the species involved were mis-identified, the specimens were returned to a country for re-introduction and USDI retained the specimens after confiscation for utilization by one of their agencies. While somewhat confusing to all involved on behalf of the AAZPA, and in particular the institutions that agreed to accept the specimens, everyone has been most understanding and cooperative. This cooperative attitude has allowed the program to continue.

A total of five species representing 3,576 specimens were not accepted by AAZPA for Clearinghouse distribution. All but six of the total specimens were represented by four common psittacine species and represented numbers too large to be suitably placed. The remaining six specimens, one species, were unable to be placed due to complicating factors involving USDA quarantine charges.

As expected, we have experienced some minor difficulties involving both USDI and AAZPA in various operational aspects of the program. All have been resolved and appear to have made the operation of the Clearinghouse more manageable. USDA is in the preliminary investigative stages of establishing a similar program with AAZPA. The advantages the program has provided to USDI are obvious, those provided to AAZPA and its members are for the most part somewhat more esoteric. In the final analysis, we are assisting in the attempt to prohibit illegal wildlife from becoming available to those incapable of providing proper care.

Several aspects of the program need to be brought forth at this time so that all participants are aware of current developments.

...Any institution not currently participating in the program will be afforded an opportunity to join during December of each year. A notice will appear in the December newsletter. Additionally, all non-participating members will be contacted and requested to participate.

...Any non-accredited institution currently not participating may sign the MOP at the time accreditation is granted and become a participant.

...All participants will be reviewed on a regular basis to upgrade all pertinent information and make any changes they feel are necessary at the time of review.

...Any new participating institutions will be automatically placed at the bottom of the various rotational lists on the date participation becomes effective.

The operation appears more difficult on paper then occurs in actual operation. As we had anticipated, the necessity to walk or work through several actual confiscations has been most helpful. There are numerous unanswered questions, on both sides, and continued cooperation of all individuals and organizations is vital.

THE SSP SUBSPECIES DILEMMA; a report of an exploratory meeting of the AAZPA Species Survival Plan Subcommittee (SSPC) of the Wildlife Conservation and Management Committee.

(This is the result of the SSP Subcommittee meeting hosted by the Philadelphia Zoological Society in July 1985. Nearly all members of the subcommittee were in attendance and contributed to this paper.)

The SSP Subspecies Problem

The AAZPA SSP was created to muster nationwide zoo collaboration in support of biological conservation. The "species" was chosen as the unit of animal preservation and more than 30 SSP species propagation programs are underway. The progress of several of these efforts is troubled by the uncertainties and inappropriateness of current classifications where "subspecies" have been designated. Zoo space to care for long-term SSP breeding groups is limited. An optimistic view (See Conway, IZY 1985) is that room to sustain approximately 925 species might be available. The inescapable conclusions are that each animal chosen for SSP preservation must be selected with great care and that research in AI, embryo transfer and cryobiology must be greatly intensified to enable captive habitat to carry more species.

Is SSP preserving "species," "subspecies," "populations,"---what defined by whom? The scope of the question is reflected in the fact that approximately 40% of the taxa used by zoos to report animals to ISIS are identified by trinomials; 16 of the 33 SSP species.

At Philadelphia, the goal of the SSPC was to begin the process of providing guidance to the AAZPA Board and SSP Propagation Groups by identifying the nature and significance of the "SSP Subspecies Problem" and ways to approach its resolution; a first exploration.

Questions facing the SSP

Specific questions troubling SSP propagation groups and would-be groups include:

. Should male Sri Lankan elephants be included in the Asiatic elephant SSP?

. Should lion and tiger subspecies be organized under single species coordinators as separate populations allowing for a later decision on whether to mix subspecies?

. Should the Indian lion subspecies be an SSP animal?

. How should the SSP deal with the black rhino program in terms of the many described subspecies?

. Many orang utans are of unknown provenance and not all hybrids are identified (although techniques are now available to identify them and about 77 are known). Should orang hybrids be denied access to the SSP program? Should the two recognized races of the orang be sustained in the SSP?

. Should Sumatran rhinos from Peninsular Malayasia and Sabah be mixed in an SSP program?

To provide a basis for discussion, the chairman presented a broader series of questions and asked Ryder, Ballou, Foose, Rabb, Ralls and Wharton to chair specific discussions. Set forth below is a summary of these questions, and the discussions that followed.

Note: Major considerations and specific recommendations are highlighted in the report.

- How shall SSP Taxa be defined? With what tools?
- Of what utility are these tools with different vertebrate taxa?
- Can we set forth a preliminary algorithm to guide the designation of SSP taxa?
- How different are "subspecies" within a species?
- What loss is inherent in the restriction of SSP designation to one subspecies of a population?
- Where "subspecies" of a species are recognized, under what circumstances can more than one form of a taxon be designated for SSP?
- Under what circumstances can hybridization of subspecies be an SSP management technique?
- How shall SSP treat long-mixed populations such as barasingha, African lion, Przewalski horse, Asian elephant?
- What direction can SSPC offer to collecting efforts designed to rescue vanishing species or to obtain reinforcing genetic representation from nature for the captive Ark?

Discussion

Subspecific classification

Zoo biologists not actively working in systematics and taxonomy often give much attention to subspecific classification. Faced with very small numbers of live animals in a zoo, far from their original ranges and frequently distinguishable morphologically, it is easy for a zoo scientist to forget that a trinomial may originally have been applied for reasons that would now be considered trivial.

While the current subspecies classification may accurately define forms far differentiated toward becoming a species, it may also distinguish much less significantly different ones that do not correspond to definable genetic units. Little congruence has been found between many current subspecific classifications and electrophoretically definable populations.

Protracted discussion of the applicability of present subspecific classifications as a basis for establishing genetically coherent SSP subspecies populations concluded discouragingly. **There is little evidence that present subspecies classifications can be accepted for SSP purposes without further study,** which might, however, be elicited from the systematics community. In fact, the meeting concluded that **the SSP should attempt to avoid the term "subspecies" altogether.**

Defining SSP taxa

In seeking to define taxa for preservation in the SSP program, the meeting eventually adopted the unwieldy but expressive term, evolutionarily significant unit, or "ESU" to express what it is that SSP programs are trying to preserve--what species or fragment of a species. In this report, ESU is used to mean a definable, hence unique genetically coherent population of a species which may be accorded SSP status; its boundaries may or may not be congruent with present subspecies classifications. Thus there may be more than one ESU within a species.

It is important that SSP groups not accept, a priori, present classifications of subspecies as a substitute for an evolutionarily significant unit. **The meeting could not avoid the conclusion that the classification of each animal adopted for the SSP would have to be investigated anew.** The tools for such investigations are several.

Tools for defining ESUs

Morphometrics (using museum materials checked for sample-size and origin) , range and distribution--allopatry and sympatry--and their temporal aspects, field observation (deemed especially important), Ne, reproductive patterns, hybridization records, pedigree analysis, outbreeding (zoo outbreeding depressions identified thus far show chromosomal rather than gene incongruities) and inbreeding depression, and such components of fitness as can be studied (if any) are all useful tools in the task of ESU classification. **Propagation Groups should begin their study immediately.**

Genetic tools for determining divergence from related taxa include chromosome analysis and gel electrophoresis. More sophisticated and expensive techniques (e.g. DNA mapping or study of restriction fragment length polymorphisms) may be practical for the Pongidae because of the applicability of techniques and interests of scientists analyzing human populations. Detailed molecular gene maps may not help SSP managers; they may be most informative in reconstructing phylogeny for some believe that they apply primarily to higher taxonomic levels. In this connection, it is important to note that the single most important data set for separating orangs has proven to be the one derived from chromosomal analysis.

Distinctions made with each of these tools for delimiting ESUs include varying ranges of uncertainty. Allele frequencies in some lek species vary from year to year--an observation which may prove common to many forms. Chromosomes from scarcely half of the known mammalian species have been studied, most only partly, and far fewer such studies have been made for birds. Nevertheless, "new" muntjac species have been defined chromosomally, dik-dik are chromosomally distinguishable and Sommering's gazelles differ from Sommering's gazelles. The Asiatic lion appears to have a fixed chromosomal difference from the African lion. Squirrel monkeys, morphologically distinguished mostly in their "eyebrows," are chromosomally distinct; the hybridization of such distinct forms frequently results in lowered reproduction. **The importance of using modern procedures to define SSP ESUs is emphasized by the fact that problems may not "show up" until the F2 generation.**

Whereas some current subspecific distinctions may be very large, others may represent the expression of alleles at single gene loci. This problem extends to all taxonomic levels; for example, does the addax deserve its own genus because of its twisted horns?. Furthermore, the degree of difference in electrophoretic analysis that might define a bird species may reflect only interindividual variation within a mammal species. For example, electrophoretic studies of the three forms of golden lion tamarin suggest little justification for recent proposals that each be accorded species status on the basis of their dramatically different pelage coloration and slightly different proportions; comparable electrophoretic differences between birds would be considered large. The magnitude of identifiable differences between ESUs can not be expected to be consistent in biological populations diverging at different rates in different ways.

No one tool for the identification of ESUs is adequate and the SSP needs techniques that will work on small samples of animals now reduced in nature and rare in captivity.

Seeking for concordances

Inevitably, the uncertainty inherent in the classification process leads to the recommendation that **studies seeking to identify SSP ESUs seek for concordances between criteria** (between data sets, not just within them), paying special attention to geographic evidence and being suspicious of any ESU definition inconsistent with geographic data.

The cost of exploring the borders of ESUs is no small consideration. SSPC's advisors suggested that:

> 1) electrophoresis might prove the most cost-effective genetic test for mammals, although a one-sided one. Possibly mitochondrial DNA studies or behavioral traits will be more useful in birds. If significant differences are found, concordant with geography and other criteria, the basis for the definition of an ESU might be in hand. If not, we must look further; 2) consider chromosomes, then 3) morphometric tests...not forgetting that such tests are no better than the data to which they are applied.

Sample size and origin require special scrutiny. Throughout the discussions of criteria, the importance of evidence of geographic origin was emphasized--**no better arguement can be presented for the importance of gathering geographic data in all future collecting efforts.** It should also be emphasized that the above ranking of tests is preliminary.

Preservation of frozen tissue

The lack of historical information from zoo collections (as frozen tissue and gametes) for electrophoretic analysis is a serious hinderance in our taxonomic tasks. Few collections currently maintain such materials. It is troubling, for example, that no such tissues were saved from the recently imported Natal black rhinos although all were of known origin. **The SSPC recommends to the AAZPA Board that it encourage the AAZV to establish frozen tissue banks suitable for electrophoretic study for as many species as possible, especially those presently or likely to soon become SSP ESUs. It further recommends that each SSP Propagation Group include a zoo veterinarian.**

A procedure for SSP Propagation Groups to follow

To be usable to SSP Propagation Groups, the process and the tools necessary to identify an ESU must be reduced to a practical step-by-step procedure, an algorithm.

The meeting gave much thought to the criteria necessary to the decisions that must go into the establishment of SSPs for more than one ESU of a species or, alternatively, to merge the units of a species. **Our preliminary algorithm includes decision points that begin with those necessary to determine whether there are, in fact, more than one ESU in the species--whether the subspecies are "any good;" whether the ESUs are mergeable without adverse consequences from coadapted gene complexes or chromosomal incongruities or from other aspects of an ESU's biology; whether captive habitat is available for more than one ESU in population sizes sufficient to meet the Front Royal recommendations "that captive populations be established that are capable of sustaining at least 90% of heterozygosity for 200 years;" and, of course, the need to make every effort to preserve future options.**

Clearly all of these decision points will be impacted by varying outside factors over time. Although the preferred option is to care for as many ESUs as possible, biologically sound ways to determine what is reasonable are not in common use. Thus the SSPC concluded that it would present a step-by-step procedure to Propagation Groups emphasizing biological criteria insomuch as those of space and cost will vary in unforseeable ways.

A preliminary algorithm was proposed by Tom Foose. It is now being revised and will be circulated to the SSPC and its advisors for further study and eventual presentation to SSP Propagation Groups and the Board.

Merging ESUs

Are there biological or other reasons to preserve locally adapted or definable forms? It is clear that there is a special need to study the question of when the merger of ESUs is justified and the consequent implications for SSP management and possible reintroductions to nature from captive stocks.

ESUs should be merged only under special conditions of stress and after careful study. Once they have been hybridized, other options are lost. The Philadelphia meeting concluded that merging was justified when populations were very small if that would facilitate saving the higher taxon.

Where the captive population is already mixed

Where the SSP is faced with populations of animals believed to represent mixtures of more than one ESU, genetic analyses should be undertaken and the introgression(s) carefully documented. In many instances, there may be no great urgency for action. It should be remembered that introgression is a natural process. Besides, we are uncertain about the effect of selective regimes in captivity. In some instances, there appears to be more variability in zoo populations than might be expected, certainly more than in the last tiny remnants of wild populations. The amount of variability in captive golden lion tamarins almost certainly exceeds that in the tiny remaining wild population and even that identified in the long-inbred Przewalski horse is surprisingly broad.

Where problems exist, the Species Coordinator should identify the scientific question to the SSPC. The Propagation Group may choose, upon the basis of careful investigation of the introgression and the implications of each case and also pursuant to SSPC study, to consider at least three options:

a. Introgressions may be removed by selection where the addition has been recent and the removal may take place without endangering the population's viability or genetic variability.

b. "Outliers" may be removed from populations where introgression occurred long ago and the removal of introgressions would not impose too severe a stress upon the viability or variability of the population.

c. Document the introgression(s) but take no action.

The decision of whether or not to accord SSP status to such a population can be made on the basis of the procedure now being developed.

Obtaining and rescuing animals from threatened habitats

Increasingly, zoos are being asked to undertake "rescue" missions to save the remnants of endangered wild animals where their preservation can not be adequately assured in nature. Such efforts, and those designed to obtain reinforcing genetic representation from nature for existing captive populations, are also faced with the subspecies problem; what to take from where...if any choice remains.

These questions have broad implications for nature conservation as well as for the operation of SSP programs. The SSPC and its advisors believe that it is presumptuous to operate upon an assumption that, "Sufficient habitat for species X will not or can not exist in nature."

Many field biologists are poorly informed not only about the nature and capabilities of modern captive propagation in particular but also about the biology of small populations in general. Thus, at one recent meeting, a field biologist insisted that all described races of the black rhino should be sustained in captivity and managed separately--without knowing whether these races are valid (doubtful), understanding the biological limitations of small populations or the logistical ones of captive habitat. At another meeting, a primatologist argued against captive propagation for a Latin American species now reduced to three or four disjunct wild populations not one of which numbers as many as fifty. **In rescue applications, SSP decision analysis needs to begin with the educational question, "Is any form of intervention likely to improve the survival prospects of the ESU?"**

Additional considerations should include the consequences of delay in founding a captive population; the minimum number of founders required in a species-specific plan--given predictable variations in survival through capture and acclimatization and expected subsequent reproductive performance rates; whether or not the species has significant substructure (more than one ESU); what the probable impact upon the survival of the remaining population of removing N animals may be; whether there is captive habitat... and so into the basic SSP algorithm being developed by SSPC for determining whether more than one ESU of a species can be sustained in the SSP program.

Getting help and filling needs

Zoo biologists need help in identifying valid subspecies-ESUs. Ralls will discuss with the American Society of Mammalogy, others will suggest advisors on particular taxa); further meetings and scientific advisors will be needed and **there is a special need to develop models based upon concrete cases as guides for the Species Coordinators.** This last must await the completion of the work assigned at this meeting.

Importance of the AAZPA Annual Conference to the SSP

The AAZPA Annual Conference is a unique and critically important forum for the dissemination of information essential to the long-term survival of zoo collections and of species dependant upon them. Despite the fact that the Association has greatly increased its focus upon animal concerns with the advent of the many SSP specialist meetings, the need to further enlarge the biological component of the Conference is sorely felt.

THE ADVANTAGES OF USING BACHELOR HERDS TO MANAGE SURPLUS MALES IN PRZEWALSKI'S HORSES

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Most animals produce a 50:50 sex ratio of offspring (Fisher 1930). In polygynous species this creates a surplus of males, because a few dominant males can usurp all the females, thereby excluding subordinate males from the breeding population. For zoological institutions which display harem-forming species, the problem becomes what to do with the excess males while retaining them as reserve breeding stock. My general suggestion for dealing with this problem is to find out as much as possible about what happens to surplus males in the wild in that particular species, or a closely related species, and then duplicate that process as closely as possible in the zoo setting. There is a lot one can do, simply by manipulating the timing and sequencing of removals and introductions, to mimic natural processes of juvenile dispersal or mate acquisition. In this paper I propose some suggestions for managing surplus Przewalski's horse (*Equus przewalskii*) stallions based on the equid research that I and others have done, and on my current research concerning the behavior of Przewalski's horses. These suggestions should also be applicable to other harem-forming equids, such as plains zebras (*E. burchelli*) and mountain zebras (*E. zebra*).

Dispersal Of Juvenile Males From Their Natal Band

Young male feral horses (*E. caballus*) leave their natal bands at 1 to 2 years of age and form bachelor herds (Boyd 1980, Keiper 1985). Penzhorn (1984) reports that Cape Mountain zebras do not leave their natal bands until they are 4 years old. Occasionally the juveniles are driven off by their father, but often they leave of their own volition (Boyd 1980, Rubenstein 1982), probably due to a lack of breeding opportunities in their natal band, and the lure of playmates in bachelor herds. Zoos duplicate this process by removing young males from the herd and placing them elsewhere. I would caution against removing the foals before their first birthday.

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Przewalski's horse foals usually nurse until they are at least one year old. Also, if the colts are left in the band for a year, they will be present during the next breeding season, and perhaps they can learn proper reproductive behavior by observing the stallion.

Formation Of Bachelor Herds

When the colts are removed from their natal band, it is important that they be placed with other male companions to form bachelor herds, and not kept as solitary animals. There are many reasons for this. Horses are very social animals. Only 0.25 per cent of the feral horses observed by Miller (1980) during aerial censuses were solitary. Solitary domestic horses are more likely to develop vices such as wood-chewing and wind-sucking to occupy their time, and these particular vices can lead to colic. Horses depend on one another for protection against insects, and for care of their coats. In one herd of Przewalski's horses that I recently observed, the animals spent twice as much time grooming one another as they did self-grooming. Forming bachelor herds is particularly important as young males spend a lot of time playing together. This play hones skills such as fighting, mounting, herding, and marking, that will be important in later life and can not be practiced without companions. If no other juvenile Przewalski's horses are available, a domestic pony can be used as a companion. One zoo has successfully exhibited their weaned Przewalski's horse colts with a Shetland pony gelding, and used the opportunity to educate visitors about the similarities and differences between the two species through the use of graphics outside the enclosure.

Bachelor herds of feral horses typically contain 2 to 4 males, but groups of up to 16 animals have been reported (Miller 1980, Keiper 1985). Miller (1980) found that some males remain together for as long as 2 years, and Penzhorn (1984) hypothesized that such individuals were kin. However, most bachelors form very fluid associations, whose membership changes frequently. In the wild, young males can associate with one another of their own volition. But in zoos, we decide the associations for the animals, and so it is not surprizing that the horses we group together don't always get along. Those animals reared together are most likely to be compatible, but usually we aren't lucky enough to be in this situation and have to group unfamiliar animals. Males of similar age and experience are most easily grouped. The problems arise when placing older experienced males and younger males together, because the older males are generally aggressive toward the juveniles, and serious injuries can result. This is going to become more of a problem in the future as older stallions are retired to bachelor herds and new stallions are rotated in and out of herds to promote outbreeding. We know that associations between old and young males occur in the wild because Penzhorn (1984) reports that deposed harem stallions join juvenile males in bachelor groups. To improve the chances of success in a zoo setting when older males are to be part of the group, I suggest assembling the herd in an area large enough for the juveniles to be able to flee. The young males should occupy the pasture for several weeks before the older stallion is introduced, so that the youngsters have the home court advantage. Introducing the adult stallion to two or more juveniles is preferable to introducing him to just one juvenile, as this spreads out the aggression, and if the juveniles are previously acquainted they may form a coalition against the older male.

On Becoming A Harem Stallion

Wild bachelors roam vast areas looking for mares. The bachelors may jointly acquire some females. What happens then depends on the dominance hierarchy of the males. If one male is clearly dominant he may oust the other males and form a single stallion harem. Occasionally the bachelors continue to jointly hold the mares and form multiple male harems.

In the zoo setting, of course, the top priority used in deciding which bachelor will become a harem stallion is its bloodline. If several bachelors of similar bloodlines are available, I would recommend choosing the dominant individual in the group, as this is the animal most likely to acquire mares in the wild. Dominance among peers gives the stallion the confidence needed to handle the mares, and removing him from the bachelor group gives the other males the opportunity to rise in rank and gain confidence. Some research indicates that stallions don't have to be dominant to their mares in order to breed successfully (Houpt and Keiper 1982), but my observations of Przewalski's horses suggest otherwise for this species. The most successful Przewalski's horse stallions are all dominant to their mares, because in the wild if they couldn't control the mares they would lose them to a competitor. One Przewalski's horse stallion was subordinate to the mares which were given to him, and was attacked by the mares whenever he tried to mount them. This male is now behaviorally impotent. This example illustrates the importance of having a dominant stallion.

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Bachelor stallions should not be used as harem stallions until they are at least 4 years old. No Red Desert feral horse stallions obtained mares before the age of 4 (Boyd 1980). Mountain zebras obtain their first females when they are 5 years old (Penzhorn 1984). Male Przewalski's horses do not become scrotal until they are 18 months old. Male secondary sex characteristics such as canine teeth and enlarged muscle masses in the neck and shoulder region do not become evident until the males are 4 to 5 years old. When juvenile males are given mares, they seldom sire foals until they reach the age of 4. In the meantime, breeding opportunities are lost, and one runs the risk of physical or psychological scars if the mares aggressively dominate the juvenile male.

To improve the chances of successful breeding, the young stallion should be paired with mares his age or younger. In the wild the 4 to 5 year-old bachelors pick up 1 to 2 year-old fillies dispersing from their natal bands, whom they can easily intimidate. Putting a novice stallion in with older experienced females is likely to result in their dominating him. When a two-year-old Przewalski's horse stallion was placed with mares ranging from 1 to 4 years of age, the only mares he dominated were the yearlings. The older experienced mares were very aggressive toward him. Currently this stallion is 3 years old and has worked his way halfway up the dominance hierarchy. The oldest mares are still dominant to him. He mounted all the mares this year, but without an erection.

Another way to improve a young stallion's chances of breeding successfully is to give him 1 or 2 females initially, rather than 10. Once he has gained experience, the harem size can be increased. Keiper (1985) found that a feral stallion's harem size peaked when the stallion was 9 to 12 years old. The average number of females in plains zebra harems was 2 to 2.8 females (Klingel 1969). The average number of females in Red Desert feral horse bands was 2 to 2.9 females. The largest Red Desert harem consisted of more than 10 mares in 1978, however the stallion lost all but 3 mares the following year. Since even exceptional wild stallions rarely obtain 10 mares, I recommend that zoo stallions be given no more than 5 or 6 adult mares to contend with.

Summary Of Recommendations

Colts should be left in their natal bands until they are at least one year old, whenever possible. They should then be used to form bachelor herds, rather than housed solitarily. The composition of bachelor herds and order of introduction of individuals into the bachelor herd should be carefully considered, with older or more dominant individuals introduced last. Bachelors should not be used for breeding until they are at least 4 years old. All else being equal, the most dominant bachelor in the group should be the first used for breeding. This novice stallion should initially be paired with 1 or 2 mares who are his age or younger, until he acquires experience.

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A CONSERVATION PROGRAM FOR GOLDEN LION TAMARINS

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In 1984 and 1985, a Brazilian-American team reintroduced a total of 24 captive-born golden lion tamarins (*Leontopithecus rosalia*) into native forest. These reintroductions are only one component of an international conservation program for this species (Kleiman, Beck, Dietz, Dietz, Ballou and Coimbra-Filho, in press). Indeed, the reintroduction of captive-born animals can not proceed sensibly or responsibly in the absence of: 1) a research and management program that results in a self-sustaining, harvestable captive population, 2) a field study of the size, distribution, and behavioral ecology of the wild population, 3) a program to identify, protect, manage, and restore tracts of suitable habitat, and 4) a conservation education program to produce public support for conservation and to train conservation biologists from the host country.

Kleiman and Coimbra-Filho have led the management program that has brought the captive population from fewer than 80 in the early 1970's to over 400 presently. Kleiman's research (e.g., Kleiman, 1977) demonstrated that golden lion tamarins should be kept in pairs rather than in multi-male, multi-female groups, and that offspring had to participate in the rearing of younger siblings to gain full adult behavioral competence. These findings, coupled with advances in nutrition and veterinary care, were keys to increased natality and decreased mortality. More recently, Ballou (1985) has applied modern principles of genetic and demographic management of small populations to equalize founder representation and stabilize age-sex structure. The Golden Lion Tamarin Management Agreement and the cooperation and support of some 50 zoos worldwide have been pivotal to all these successes.

J. Dietz is conducting the field study in the Poco das Antas Biological Reserve, about 90 miles northeast of Rio de Janeiro. Dietz and the young Brazilian biologists that he has trained have found that the entire wild population numbers about 350. About 115 live wholly or partly in Poco das Antas and thus are protected. Another 100 live on a nearby naval reserve, and another 100 or more live in isolated groups on remnant forest islands. Dietz is studying group size, home range size, food preferences, forest types, and critical resources, knowledge of which is essential for reintroduction success.

The 5,000 hectare Poco das Antas Reserve was established in 1974. About 40% of the Reserve is primary and secondary forest, and the balance is regenerating pasture. The Denver, Apenheul, Oklahoma City, Tulsa, Audubon Park, Seattle, Adelaide and National Zoos, and the Tulsa AAZK chapter contributed over $10,000 to our efforts to protect and restore the Reserve.

L.A. Dietz has implemented a multi-faceted conservation education program around the golden lion tamarin. Structured interviews with residents living near the Reserve established a baseline of attitudes (quite favorable) toward forests, tamarins, and conservation. Ms. Dietz then started a national media campaign and, at the local level, organized grass roots conservation clubs; published pamphlets and posters; distributed buttons and stickers; penetrated schools with special classes, essay contests and work materials; and presented slide-tape shows, a travelling exhibit, a play and field trips for the local population. The North American team has also identified and trained young Brazilian professionals in wildlife biology, reintroduction techniques, and conservation education.

In June and July 1984, we introduced 13 captive-born golden lion tamarins and one confiscated wild-born tamarin. There was a family group of eight, and three adult pairs. They had been quarantined and trained at the Rio de Janeiro Primate Center for six months, and acclimated in large cages at the release sites in the Reserve for two to four weeks. The release sites contained no wild tamarins although the forest appeared suitable. The reintroductees were provisioned with gradually decreasing amounts of banana, orange, and ground meat for about 7 months; provisioning was discontinued in March 1985.

The released animals have been monitored almost daily; we feel this is necessary to assess the efficacy of a reintroduction program. Two of the captive-born and the wild-born animal survive today. There have been three births; two of these infants survive. Thus, the Reserve's population has grown by five.

In July 1985, we reintroduced a family group of five and another of four. The 1985 reintroductions took place in a 100-hectare forest tract on a state-owned citrus plantation about 20 miles from Poco das Antas. These nine animals are also monitored daily; all nine survive. Two additional young females, trained at NZP and in Brazil, were recently released at the 1984 site in the Reserve as potential mates for unpaired male survivors.

To summarize, 24 captive-borns (which had been born or held at the Audubon Park, Brookfield, Kings Island, Los Angeles, National, San Antonio, and Wichita Zoos) have been reintroduced, and 13 survive. Additionally, there are two surviving offspring. Causes of death or debilitation included predation, exposure, disease, starvation, snakebite, social conflict and disappearance. Most losses occurred shortly after release. The major cause of mortality was an apparent disease which affected the family group in February 1985 and resulted in the death of five animals.

Prior to the 1984 reintroduction, Beck trained the tamarins to abandon their expectation of finding cut food at a traditional place in their cage at a traditional time, and instead to search for food that was hidden and distributed in space and time. They were induced to run, jump, and climb to develop locomotor skills. Nonetheless, foraging and locomotion deficits were evident after reintroduction, especially in older individuals. Age was a key variable, with a significant negative correlation between age at reintroduction and post-reintroduction survival.

As a result, in 1985 only age-graded family groups were selected. The group of four was reintroduced without training to test the usefulness of the training procedure. The other group, with five members, was again trained to forage for distributed and embedded food, and additionally received more intensive training in locomotion. Their cage was furnished profusely with natural vegetation, especially small diameter branches and flexible vines. The entire branch and vine network was knocked down and reassembled frequently to force the animals to move through a novel three-dimensional array instead of habitually using familiar routes. Although the data are not yet fully analyzed, the trained group appeared to locomote more ably, range further, search more actively for natural food, and find more natural food. The untrained group is currently being trained in the forest. Provisioning continues, and at this writing (September 1985) there has been no mortality in these two groups. We tentatively conclude that our training is necessary but not sufficient for successful reintroduction of golden lion tamarins. The tamarins must be provisioned after release as they learn their home ranges and hone foraging skills.

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INTERACTIVE EXHIBITS AT THE MONTEREY BAY AQUARIUM

by

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Introduction

It is a commonly held notion [and a valid one, most likely] that learning is most effective when the greatest possible number of senses is brought to bear on the subject at hand. Those of us who deal with the medium of public exhibits are used to thinking that manipultive/interactive exhibits make the whole process more appealing and enjoyable, and that in this context an educational or interpretive mission is most likely to be realized. Indeed, to design an exhibit these days that is not somehow interactive or involving practically verges on heresy, and certainly carries with it the danger that one might be branded "archaic," or worse, in one's approach. I don't happen to believe that, but the pressure is felt, nevertheless.

Since most of the subjects one interprets in the context of a zoological park or aquarium are biological ones, and since the raison d'etre of these institutions is the maintenance and presentation of living organisms [for purposes of public education, research, species preservation, etc.], the challenges inherent in manipulative/involving exhibits are particularly great. Most plants and animals do not hold up well to repititious manipulation, and questions of the humaneness of such exhibits are likely to arise. Even if these are dealt with in a satisfactory manner, the problems of supply, maintenance and adequate control of the visitors' activities often make interactive exhibits with living components prohibitively expensive in terms of facilities, staff time or both.

An attempt has been made in the design of the Monterey Bay Aquarium to work through these problems and, when possible, include at least one interactive exhibit activity in each of the major gallery areas. What follows is a discussion of the problems, costs, successes and advantages of a sampling of these exhibits at the Monterey Bay Aquarium.

The Kelp Lab

The Kelp Lab is located in the Kelp Forest gallery, an area of the second floor of the aquarium opposite the large [two-story high] windows of the 335,000 gallon Kelp Forest exhibit tank. A walk through the Monterey Bay Aquarium is a walk through the major living communities of Monterey Bay and its shoreline, and the Kelp Forest exhibit is perhaps the crown jewell in this experience. This twenty-eight foot deep tank contains the major components of a living kelp forest: giant kelps, fishes, invertebrates and algae in close-to-natural assembleges. This is one of the richest and most complex of all shallow marine communities, and its interpretation is a challenge in seeing the forest for the kelps.

The most common and obvious animals and algae are identified near the windows of the tank (and above the windows of smaller tanks in the gallery) with our standard graphic "ID" panels, and additional graphic explanations of kelp forest structure and ecology are located on both the first and second floor levels. In order to provide the visitor with a close-up look at the astounding number and diversity of plants and animals in this aquatic forest, however, we elected early in the planning process to try a "lab" approach; one in which the visitor experiences some of the same opportunities for direct observation afforded college students at marine station laboratories.

The Kelp Lab is designed to make this approach possible for as many visitors as wish to avail themselves of the opportunity - and most do! Six dissecting microscopes (half of them at child's/wheelchair level) provide closeup views of a myriad of invertebrates dissected from the large, root-like holdfast of the giant kelp. Abbreviated identifying graphics help the visitor discover the name of the organism on view. Nearby small aquaria display an even greater number and variety of holdfast and forest-floor invertebrates, small fishes and algae. At the outer end of the wet table structure is an acrylic holdfast tank housing an intact kelp holdfast and an array of other showy invertebrates. Joining the holdfast tank and the childrens' microscope viewing area is a touch tank of kelp forest denizens. This shallow sea water table provides opportunities to observe and gently touch (without removing them from the water) between one and two dozen of the hardier kelp forest invertebrates and algae.

We had a number of missgivings about the feasibility of the Kelp Lab. We were warned that microscope parts would disappear within hours, children would play frisbee with the sea stars, and that the holdfast would rot and putrify within days. The volunteer Guides, it was said, would throw up their hands in dismay and demand reassignment to the sea otter exhibit within one or two stints at the Kelp Lab.

None of these catastrophes has occurred! And the Kelp Lab has become one of the most popular exhibits, not only for the general public, but for school groups, as well. And most of the credit for this goes to the volunteer Aquarium Guides who make it work. We have found that it takes three or four Guides to operate the Kelp Lab on a busy day; two helping visitors with the microscopes, and two at the small aquaria and touch tank. At three shifts per day, that is as many as twelve guides per day to operate the exhibit. All are answering questions and engaging visitors in interpretive conversation more-or-less constantly. Vastly more information is exchanged by this means than through the graphic exhibits (although the graphics are indispensible aids to the interpretive process). We find with all fifteen, or so, guides stationed throughout the aquarium at any one time, the informal small group or one-on-one interactions that transpire so frequently are among the most effective of all means of imparting information to the visitors, and the Kelp Lab has proved itself as an extremely valuable facilitator of these exchanges.

This is, of course, not without its costs and drawbacks. It takes between 350 and 400 volunteer Guides to man the Kelp Lab and other exhibit areas of the aquarium. And guides, like other volunteers, require training, supervision, evaluation, enrichment and recognition, and all this requires a volunteer staff of three full-time and four part-time people. In addition, an Education Department staff member sets up the microscopes each morning and maintains them on a regular basis (this averages about 45 minutes per day). Aquarists (Husbandry Department) do the collecting and maintenance of the live animals. These activities average one to two hours per day.

The plants and animals have given us some surprises. One holdfast lasts six weeks or longer. Most of the animals teased from the holdfast remain on exhibit for months without any indications of stress. Those that evidence stress are returned to holding tanks or to nature, as are those with food preferences that cannot be easily met in the aquarium.

In just over 2.2 million visitors this year (so far), we have had about fifteen episodes of a microscope's needing repair, and it is always due to the stripping of the magnification zoom control knob. Next year we will replace the variable magnification microsciope with models with fixed magnification, and this minor problem will disappear. All in all, the Kelp Lab stands as one of the most effective interpretive centers in the aquarium, affording the visitors a variety of interactive opportunities and access to about as much information as they may desire.

The Shale Pool

One of five habitats displayed in the other third-of-a-million-gallon (Monterey Bay Habitats) tank at the aquarium is the Shale Reef. Reefs of this relatively soft siltstone/mudstone outcrop in many locations in and around Monterey Bay. They are remarkable in that they are home to several varieties of boring clam and mussel species which make "Swiss cheese" out of the rock. These tunnels and burrows then become home for many varieties of worms, brittle stars, nestling clams, crabs, shrimps, and small fishes.

To appreciate this complex community of animals in and on the shale one must get close to the subject, and some magnification makes the experience all the more unique. Many of these colorful animals are of a size that even low power magnifying lenses bring them into clear focus, and provide a clear view of this lilliputian world.

The constraints of available space and limited light [to avoid reflections in the large viewing windows of the Monterey Bay Habitats exhibit] precluded a Kelp Lab approach to this area, and we wanted to avoid the need for full-time attendance by volunteer Guides. The Shale Pool, therefore, was designed to operate as a "self-guided" experience, with identification graphics providing the needed information for the visitor.

The Shale Pool is about eighteen inches deep, and contains several pieces of shale from Monterey Bay arranged to lie about four inches below the water's surface. Floating magnifiers were designed and fabricated in-house. Four of these eight-inch diameter lenses are tethered to the side of the pool, and may be moved to any desired position within the radius provided by the 1/8 inch polypropylene tether.

The views through the magnifiers are spectacular, and give the visitor the feeling of a rare and intimate glimpse of this complex community of invertebrates and fishes. Because of the constant availability of raw sea water in the aquarium the animals in and on the shale thrive in this exhibit, and replacement of the animals attached to or crawling over the shale is rarely necessary. Many, like the worms, bryozoans, clams and sponges are filter-feeders, and all the food they need is provided by the plankton and other particles in the raw sea water. Fouling does not occur since the low light intensity inhibits the diatoms and other fouling algae, and the predators keep the invertebrate fouling community under control.

The exhibit works well in the absence of Guides. One magnifier sank our first week of operation, but aside from that episode, no repair or replacement has been required. An average amount of attention by aquarists is required, but no more than for any other exhibit of this size. The visitors regulate themselves, and the constant presence of two or three people waiting to use the magnifiers seems to keep people moving pretty well. No fist fights have broken out to date [that we know of]. Foreign objects in the low, open tank have not been a problem. Visitors seem to sense that these special exhibits require special care and attention, and this is generally forthcoming.

The Touch Pool

Perhaps the most active and interactive exhibit at the aquarium is the touch pool. This, of course, comes as no surprise to anyone who has experienced similar exhibits around the country, where for kids of all ages the chance to observe unfamiliar (and even familiar!) animals at close range and with direct contact is nearly always a highlight, if not a show-stopper. The challenge is to provide an enjoyable learning experience for large numbers of visitors without adverse effects on the animals (and volunteers!) which populate the exhibit.

A well planned and structured touch pool exhibit can accomplish many worthwhile interpretive/educational objectives. There are, however, some potential pitfalls to be avoided.

Most visitors to aquariums have never experienced a tide pool and its inhabitants in nature. Most do not understand the paradoxical fragility of these animals found living in harsh, constantly changing environment of the exposed rocky coast. And most have little understanding of the basic biology of common tide pool denizens (sea stars, mussels, turban snails, abalone, chitons, etc.). Hence, the touch pool, having attracted the visitor via its intriguing interactive aspects, presents an opportunity for a rich interpretive exchange at nearly every level of sophistication. And it lends itself beautifully to the realization of this opportunity so long as trained Aquarium Guides are on hand as interpreters, as traffic coordinators, and to look after the health and welfare of the animals.

Some aspects of animal welfare are related to the design of the pool. Shallow touch areas are shelves around the perimeter of the tank, while deeper, central "rest areas" provide space where animals are "off duty" for as long as is necessary. A recurved lip beneath the wide railing of the tank keeps all but the most adventurous animals from crawling out of the water. A rapid flow of fresh sea water maintains high oxygen levels and a temperature identical to that of Monterey Bay. Daily cleaning and about weekly rotation of the animals back to nature is accomplished by an aquarist prior to our 1000 hrs. opening time. Guides are sensitive to the first signs of stress in the animals, and remove them from exhibit as needed.

Signs of stress among the Guides are also taken seriously, and they are not infrequent. The Touch Pool is constantly busy, and few opportunities arise for drying and warming one's hands or for taking one's self off exhibit. Busy periods require four Guides or Apprentice Guides in attendance, and they are all busy. For this reason, we try to rotate Guides to the Touch Pool every hour and-a-half from other exhibit areas, so that hands can warm up and burnout can be minimized. A full three-hour shift at the Touch Pool is taxing to the extreme, and we try to avoid this during all but he least busy periods (and they are few in number!).

Although supported by ID graphics and instructional signage, it is the Guides that really make the Touch Pool work to its full advantage. Their enthusiasm is catching, and they are able to tailor the interpretive exchange to the needs of each visitor (or

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group of visitors], be they school children, college students or a family from Nebraska. The close proximity of the Touch Pool to the Rocky Shores and Wave Crash exhibits, the Tide Pools exhibit, and the real tide pools just outside the door make relating the Touch Pool messages to the broader context of the rocky shores habitat as easy and convenient as can be. Including a conservation/environmental awareness consciousness message in the Touch Pool experience thus becomes a natural and immediately attainable objective.

Conclusion

If the goal of interpretive exhibits is to provide the visitor with new areas of understanding and awareness, and an inclination to be enthusiastic about newfound areas of interest, then the interactive exhibits at the aquarium appear to have fulfilled this goal. All three exhibits discussed here impart knowledge in enjoyable and engaging ways, and at a variety of levels which are easily adjusted [by the Guides] to the needs and expectations of the visitors. The exhibits, although just fragments of the real world, look out [sometimes literally] to the broader living communities nearby, which comprise the main interpretive theme of the aquarium. They work equally well for the general aquarium visitor, and as complimentary elements to the aquarium classroom programs of scheduled school groups.

The costs are high, primarily in terms of volunteer time, and the Kelp Lab and Touch Pool simply could not operate at nearly their present levels of volume or effectiveness without adequate numbers of trained Guides at all times. The results, both for the experience of the visitors, and in the satisfaction realized by the volunteers, appear to be well worth the investment.

PRIMATE DISCOVERY CENTER

Integration of Education and Animal Exhibitry

Margaret Burks, Executive Director
San Francisco Zoological Society

The Primate Discovery Center opened at the San Francisco Zoo in April of this year, after nearly two years of planning, three years of fundraising and three years of construction. These three primary functions overlapped, and the design development and modification process of the interpretive center was continuous nearly throughout the five year period. The facility itself is a new $7 million complex for 16 species of monkeys and prosimians, including a nocturnal section, atriums, meadows, streams, two-level walkways, surrounding Discovery Hall.

The Phoebe Hearst Discovery Hall is the heart of the Center - an innovative, interactive experience for zoo visitors comprising 23 exhibits, most of which are interactive, ranging from four laser disc computer terminals to a wooden bench on which sits a fibreglas monkey below the inscription "This Bench Reserved for Primates Only." This simple bench is probably now the most popular photo spot in the zoo, perhaps the least expensive of the interpretive exhibits, and even it underwent at least five major conceptual revisions during the development process.

I'd like you to see a short video called "The Evolving Zoo" which shows the Primate Center and tells about the planning and development process from the perspective of our exhibit designers. Understanding how exhibit designers see themselves (essentially as educators, not just designers in this instance)- whether they are in-house or outside professionals - is an important aspect of successful planning. This film is directed at what I call the "extended family" - boards of trustees, potential donors, volunteer groups, governing agencies, perhaps zoo architects and planners.

--- FILM ---

Since the Primate Center opened, zoo attendance is up 40% and we've had outstanding response to a new member direct mail campaign. Our membership a year ago was 12,000 and today we are at 25,000. The Center has received highly favorable media attention, extended coverage on tv, on radio, in print, and it's received architectural awards, positive editorial comment...all we could have hoped for and then some.

Discovery Hall itself is used constantly and in many different kinds of ways (some of which are perhaps more recreational than educators would like) as we expected. It is providing a truly new kind of public experience at the San Francisco Zoo, and more formal evaluations will be made in the coming months, with the expectation that we will modify, delete and add (perhaps 10% per year) exhibits, taking the position that interpretive exhibits are much like animal exhibits: ongoing, never-ending development that typifies zoos responding to the needs of animals and public expectations.

Our exhibit designers took an experimental approach and originally proposed about thirty different interactive exhibits, which went through a process of refinement down to 23. Both life-sized and scale models were built of most exhibits and the focus was always on delivery of the educational message. Graphic signage at each animal exhibit referred visitors back to the Discovery Hall computers to ask further questions.

The exhibits were fabricated by another firm, and their role was more clearly engineering and construction, backed up for a one year warranty: if it doesn't work, do it over. At the end of our first summer, the design team and the fabricator agreed that "a zoo audience is not the same as a museum audience." We replied "That's what we told you from the beginning." The relationship between the designer and the fabricator was particularly important in our experience, particularly in exercising quality control. It would parallel the relationship you'd also like to have between your architect and your general contractor, between the general and his subs - but in this instance the quality control level between the designer and the fabricator was by far the best we experienced throughout the entire construction process.

I won't address what is probably your number one concern: the quality of education your visitor will receive. Most of you are professionals at that and know far more than I. But I would like to address how you might have a larger role in the development process in response to concerns I've heard over the years, which relate to comments such as "the animal people give lip service to education, but we're treated as outsiders," "second-class," "don't have the impact we'd like," "it's still a billboard approach to zoo education," "interactive exhibits won't work," "why spend money on fancy gadgets when we all know people come to see the animals,"...and so forth.

The key, at least what worked in San Francisco, is that the educational component was integrated into animal exhibitry in a single project. Discovery Hall was the real reason we successfully funded the entire project; it was certainly the most innovative aspect and generated excitement, provided a solid rationale for donors at all levels, and had a ripple effect on what was perceived as possible to accomplish at the zoo. I would suggest that educators never plan interpretive exhibits unless plans include animal exhibits. Maximize the mileage you can get. Take on a major role in shaping the future of your institution.

This combination of education and animal exhibits, I believe, gives an instituion the strongest possible position for success -- the ability to undertake major projects that in the end serve the needs of the people lining up at the admission booth.

I'd also suggest that educators take a leadership role in solving some of the problems your director has.

* Develop the criteria by which exhibits will be evaluated, right from the beginning. It will help your institution to avoid the whims of the rich and powerful and uninformed.

* Let your director, the exhibit designers, your animal management staff, all who will be involved, know the extend of input and volunteer participation they should expect, and how you plan to manage it. A lot of problems can be avoided if the expectations of all participants are realistic and given some thought, early on.

* In your staff work with your Education Committee and other participants in the planning process, reinforce the essential principle that you don't in the end design, plan or build by committee (or at least try not to). "Input" needs to be given in a realistic context. Education professionals can help a director a lot in this regard. And use the word "draft"...a great way to take in a lot of input.

* Educate your volunteers. Calm your docent group that may feel threatened by technology. Stress the importance of people in programming. There is room for both people and technology. Work up statistics on the number of visitors public educational exhibits will serve, in addition to touring.

* When decisions are made, make sure you know why, and then YOU communicate the 'why' to your own particular constituency.

* Educate your key trustees involved in the planning process, and educate your colleagues within your institution. Plan visits to other facilities, send copies of relevant articles and publications, bring in outside experts where appropriate, suggest you'd like input in "draft" form. The more you teach your constituency, the better off you'll be.

* Use your director. Tell him/her what responsibility you are prepared to take and how you'll keep him/her informed. Learn to use your director with your docents, your technicians, your staff, your volunteers. Ask your director to help you. Tell how.

* Take the responsibility to get the best possible work from exhibit designers. You have to make them understand and respond to what your needs are. Don't assume anything. Put your program in writing as soon as you can. Challenge and examine everything. Plan your time, then double the amount. They will need you.

* And, please, don't assume because you're a professional educator that you know everything and that management "doesn't understand." It's your job to make your management understand. And, ease up. If you quibble over a word, be prepared to suggest something better.

* And remember not everybody has to use an interactive exhibit just like you'd like him to. Having fun is OK, too.

A SURVEY OF INTERACTIVE TECHNOLOGIES

By David M. Jenkins
Coordinator, Museum of Natural Sciences, Toledo Zoo

I. INTRODUCTION:

For over a century, zoos and aquariums have been a locus where visitors can see some of the extraordinary diversity of life on earth. As we near the 21st Century, this is no longer enough.

Our visitors and their children must come to a fuller understanding of the plant and animal biosphere, and how fragile it all is. We, along with all other similar institutions, must reinforce an appreciation and concern for that which we hold in trust.

There are many ways to achieve this and we must explore them all. Fortunately, there is available to us today a growing body of techniques to involve the individual visitor as well as the family in a learning process. They range from carefully designed play activities for children to advanced technologies in computers and microscopes. Across the country, these techniques are being used to the enhancement of institution and visitor alike. In time, they will revolutionize our methods of public education.

Every zoo and aquarium has an untapped well of creativity in its institutional staff and in the surrounding university and business community. Interactive technologies, from simple pre-school games to fiber optics, is a field we can use help from a vast array of talent. Out of all of this will come the new ideas and concepts that we need.

We must be prepared to fail. To only copy the success of others will lead to stagnation. We must experiment and evaluate. We must not allow the potential vandalism of a few to limit the opportunities of the many. Instead, consider vandalism as an exhibit problem, then design solutions to overcome it.

Nor must we let the success of new technology overshadow the greater goals of conservation education. A device may work and prove very popular, but if it does not build respect and understanding for life, then we have succeeded technically, and failed philosophically.

II. CATEGORIES OF INTERACTIVE EXHIBITS:

To try to categorize interactive technologies is difficult for it is a still-evolving field. The following system is based on the nature of the activity, as opposed to the nature of the device involved.

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A. Comparisons.

Traditionally, comparisons have been done with flat graphics and text. Interactive devices allow a much more dramatic experience. There are probably five major types of comparisons which zoos and aquariums are most concerned with: biome/biome; plant/plant; plant/animal; animal/animal; and animal/human. Of these, this brief survey has located examples of the latter two.

1. Animal/Animal Comparisons.

Most of the technology used here is relatively simple and basically a modification of a static graphic. The Noorder Dierenpark Zoo in Emmen, Neatherlands has a large range map of tiger subspecies, with visitor push buttons to illuminate past and present ranges. The Honolulu Zoo has a series of nice graphics that use a wheel or lift doors to expose answers. A step beyond that are the electronic graphics at Lincoln Park Zoo on animal speed.

Still more sophisticated is a graphic that can shift, changing illumination to show internal anatomy. At Lincoln Park, this shifts from an exterior to skeletal view of the dog and cat. The most dramatic of these shift-changing units are the dissolve units at Sonora Desert Museum, one of the real pioneers in bringing museum technology into the zoo environment. Dissolve units can show anatomy or fade back and forth between ecological equivalents. The Cincinnati Museum of Natural History has dissolve units that contrast summer/winter color changes. All of these devices can be activated by push buttons or run automatically.

2. Animal/Human Comparisons.

In all visitor interactions, there is always at least one animal present; one yardstick we are already comfortable with. At San Diego's Wild Animal Park and at San Francisco's Primate Discovery Center, a flat life-size graphic of a gorilla is used for size comparisons. The Pueblo Zoo has a delightful discovery room with a multi-animal graphic from the smallest human to the tallest giraffe. The Dallas Children's Zoo has a large graphic of many zoo animals. Take the comparison concept another step and add a weight scale. San Francisco uses it to allow visitors to compare their weight to various primates, Dallas to compare with a whole array of zoo animals, and in the Cincinnati's Insectarium, a scale is used to equate human weight with the equivalent number of insects.

Animal/human comparisons can be a whole body experience, involving jumping in an outdoor setting, as at the Toronto Children's Zoo. This is a fine exhibit with a safe sand box and animal comparisons that bracket a child's ability. From whole body, the concept can shift to parts. Also at Toronto, visitors can compare their feet with concrete imprints in a waterhole setting.

A step past this was taken by Macomber Farm, now under the Massachusetts SPCA. A bridge was built with footprints of various farm animals. Children are challenged to match their stride and appropriate sounds are reproduced.

Hands are wonderful for comparison, especially with primates. At the Primate Discovery Center, devices challenge visitors to pick up or manipulate objects and compare that to various primate abilities. At the Ontario Science Center, they have a grip tester, a device that could easily be modified to compare human to great ape strength. At Fort Wayne's Children's Zoo, hand comparisons are carried into the microscopic, utilizing a stereoscope.

Nor need we stop at the exterior. Interactive devices can help explore all aspects of human/animal physiology. The Ontario Science Center has devices to test flexibility, reflexes, balance and other human abilities. These could be adapted to compare with birds, rattlesnakes, squirrels and so on.

At Pueblo, a display on animal heart systems includes a pulse meter for the visitor. Commercial devices for blood pressure are now available which should make a giraffe or diving mammal comparison interesting. Also, these exhibits help humans learn about themselves, not a little thing.

The Louisville Zoo's MetaZoo has an exhibit which illuminates the interior of an elephant and human skull simultaneously; a simple but effective way to show cranial comparisons.

Perhaps the most promising area of comparative interaction is in the senses. The total animal kingdom has at least 14 senses, many of which are totally alien to us. At Monterey Bay Aquarium, reostasis is demonstrated not by a push button, but by a wheel. The degree of current produced in the tank is thus dependent on the strength and will of the visitor.

Even the senses we take for granted vary dramatically across the phyla. At MSPCA (Macomber Farm), a device was created that allows a visitor to experience split vision, as a pig might see. At Mystic Aquarium, an exhibit simulates three kinds of fish vision: double, like a mudskipper, wide angle and downward. At the MetaZoo in Louisville, a large stylized insect head was created to give one possible concept of how the world may look to an insect.

There are also important aspects to our own vision. The Primate Center in San Francisco has a unit to test binocular vision. At Washington Park Zoo, an elegant device tests monocular versus binocular vision in front of an owl exhibit by challenging the visitor to thread a bar through a hole with one eye closed. This is a particularly fine display because it is simple and durable, vital for outdoor devices.

Hearing is our other major long-range sense. The Bronx

Children's Zoo developed large ears that a child could use to simulate animal hearing. Other zoos, such as San Francisco, use recordings, in this case, of primates. A step from that, as at Fort Wayne, is to include a single trace oscilloscope, so visitors not only hear sounds, but see them as well. A step from that is the dual trace oscilliscope at Louisville, where a visitor not only hears and sees animal sounds, but can try to mimic them. At the Toledo Zoo's Diversity of Life exhibit, the dual trace oscilliscopes also have pulse activated graphics. Having the microphone for human involvement makes it the most highly used single instrument in the entire exhibit.

Smell is an area many zoos are experimenting with. As part of Fort Wayne's exhibit on senses, they created a nice graphic combined with commercially available scents.

Hot/cold sensation is rarely dealt with. At the Bronx, a heated rock was placed in front of a reptile exhibit. The Pueblo Zoo designed an ingeniously simple device, especially good in warm regions. By putting one hand on two painted stones, one black, one white, it becomes instantly obvious why color is so important in thermoregulation. This concept is exceptional because it is very low tech, no maintenance, and demonstrates how effective a direct hands-on experience can be worth.

And finally, at the Tulsa Zoo, a device is in operation that breaks into a totally different realm - time. Called the "mutascope," it allows visitors to see a film of a leaf bud opening in time-lapse photography.

B. Extending Human Senses.

This is a region of great, primarily untapped potential. By extending visitor senses into realms that are unknown to the majority, a degree of real discovery can be added to the zoo experience. It can be achieved simply by using magnifiers as part of displays. Cincinnati and Monterey Bay use them in terreria and aquaria. Louisville uses them in a variety of museum-type exhibits. They are particularly useful in drawing attention to fine details such as vestigual boa hind limbs, pits in egg shells, etc.

A step beyond the fixed magnifier is one that slides along a track, giving the visitor the opportunity to discover at their own pace. The Cincinnati's insectarium was one of the first to develop this. At Louisville, they are used in a wide variety of ways. One is as both a display case and augmentation of similar touchable objects in a young child's area.

At Toledo, they are incorporated into modular standing units featuring large insect head models and dried insects under the sliding magnifier. A large five-power magnifier is used because it begins to make visible details not readily discernible to the unaided eye. Such magnifiers are also excellent for plants, fossils and small invertebrates.

The most creative manner of usage is at Monterey Bay Aquarium. Here, the magnifiers float, allowing almost complete freedom (they are tethered) to view living benthic systems.

The next step beyond magnifiers are stereoscopic microscopes, allowing full three-dimensional viewing from 10 to 50 power. At Monterey Bay's Kelp Lab, stereoscopes are used in a monitored environment to view living specimens.

At the Ontario Science Center, stereoscopes are left unattended and the objects to be viewed are embedded in resin. At Louisville, linear plexiglass boxes slide beneath the lens. The stereoscope itself is protected by a plexiglass box from most forms of vandalism. At Toledo, a lazy susan device has been built to allow maximum viewing. It can be used for non-living specimens or living plants.

Stereoscopes not only are a fine way of extending senses, they introduce children to a genuine scientific instrument. At Toledo, as at Louisville, they are often incorporated into modular units with live animals. Stereoscopes are highly versatile. Not only can the visitor examine their own skin, rings, etc., but microlibraries can be created of everyday materials. Both Louisville and Toledo have developed these.

Single lens, compound microscopes are far more difficult for the casual visitor to see through and focus. Louisville limited their use to fixed slides. This is an area where new techniques, such as microprojectors, are needed.

Extending senses is an unlimited field. The new Cincinnati Children's Zoo is experimenting with simulated underwater periscopes. Few, if any zoos, have yet developed infrared, ultraviolet, sonar, magnetic and other senses in an interactive exhibit. The potential is enormous.

Another badly needed area of sensory extension is distance viewing. San Diego's new visitor enhancement program includes fixed telescopes at the Wild Animal Park. And though not yet interactive, video monitors, like those in use at San Diego's gorilla exhibit, open up areas to viewing that visitors cannot see. The next step would be to allow visitors to scan selected areas.

C. Learning Play.

This is the broadest, and least defined of all of these tentative categories. Many of the previous exhibits could also fit under this designation. Play is the primary learning process for young children, and certainly our most practical way to reach them.

The Bronx Children's Zoo was a pioneer, placing children in an animals environment, such as using pop-up view bubbles in a prairie dog exhibit. The Cincinnati Children's Zoo uses this technique also. The Bronx also uses play structures with animal themes, such as a rope spider web. Cincinnati took this concept and elaborated upon it with a trap-door spider exhibit, complete with pop-up door.

Toledo's Diversity of Life exhibit is experimenting with a play-pen type structure for toddlers. Too often, the very young are ignored. By interacting with stuffed animals, the infant shares a happy animal experience, and the parent gets a needed respite.

Role playing is an excellent way for children to have fun. At Toledo, a corner has been created by volunteers to be a mirror jungle, where children can use animal masks to play at being various animals. Pueblo has a similar unit.

Sea World of Ohio has made role playing an integral part of their aquatic education. Though this is in a supervised outreach program and not a public exhibit, the concept is too good to pass up, and could be adapted for monitored discovery labs. One idea is a multi-hand puppet which allows children to role play at being a coral polyp. Another technique is to dress children up as marine mammals. Simply putting on the many layers of simulated blubber to become a walrus or whale is a true lession in insulation.

The Bronx Zoo took getting into an animal outside, with large fiberglass crawl-in turtles. Cincinnati Zoo took this a step further with crawl-in turtles on wheels. There are, in fact, many animals that lend themselves to this kind of role playing. The Bronx also developed crawl-in snail shells and made sure, as with most of their interactive technology, that live animal exhibits were near-by, so the play experience can help deepen the child's understanding of the living animal.

Imaginative play is a favorite of young children. At Toledo, they can make imaginary animals on felt boards. At Fort Wayne, they use stamp pads. Honolulu uses the concept in a bird graphic where three plexiglass circles can be turned to make a "real" or imaginary bird. Cincinnati uses the idea outdoors with turnable blocks to create animals. San Francisco uses a series of turnable graphic blocks to create a primate, and Coyote Point Museum in California uses the same technique to demonstrate food chains.

Touching is a critical sense for all of us, especially children. It can be simple, using real objects such as large tortoise shells at Dallas, fossils at Toledo, or in an excellent concept, touching and guessing hidden animal forms at Cincinnati. This is a particularly good way to compensate for the inability to touch real animals, and by tying it to an adjacent raccoon exhibit, gives the children a feel for the nighttime groping that is part of a raccoon's existence.

Touching and handling can be carried further with activity areas of feathers, bones, snakeskins and other renewable resources. The young child's room at Louisville's MetaZoo is a good example.

Another fine concept is for visitors' children to make something at the zoo that they can take home as a reminder of their visit. At Louisville, they can make actual-size rubbings of elephant and rhino footprints. At San Diego's Wild Animal Park, they make rubbings of gorilla photos. At Toledo's Diversity of Life exhibit, there is an activity area where children make animal footprints and rubbings of endangered species. These brass rubbings are available for lease (see source list) and are simply splendid, both in concept and message. Handouts are available also. At Pueblo's Discovery Center, they created an elegant way, using two sheets of plexiglass, for children to make the rubbings, and a fine graphic where footprints are made.

Although it has limited application for most zoos and aquariums, the best example of this kind is at the Sonora Desert Museum, where visitors pick through a simulated mine dump, identify their finds, and begin a mineral collection they can take home. The new Los Angeles Children's Zoo may use a similar technique with shells on an artificial beach.

D. Conservation.

Interactive techniques can reinforce this, our most important message in a number of meaningful ways. Simplest, at Louisville, selected sheets of the Red Data Book were laminated with 10 ml. laminate and placed on display with graphics explaining the IUCN. This is very real data few visitors are aware of. Louisville also tried a microfiche unit to illustrate ISIS data, but it was only partially successful because the machine was too delicate for unattended public use. The new touch screen computers at San Francisco's Primate Center will hopefully prove the tool of the future for this and other vital information.

Most of this survey has focused on unattended public exhibits, interior and exterior. Monitored discovery labs such as Kelp Lab at Monterey, and the pioneer Herp Lab in Washington, allow far greater in-depth learning. Hopefully, the future will begin a fusion of all types.

Herp Lab has perhaps the best interactive exhibit in this survey. A visitor examines endangered species material and answers a series of questions, then creates a pledge card, pledging what he or she will do to help wild life conservation. The visitor posts the pledge card on a bulletin board for all to see.

This wonderfully simple idea can easily be carried further into legislative action, and the soliciting of public donations for the WWF and others. In this way, we involve the visitor in not just a learning experience, but into meaningful action.

III. SUMMARY:

What this paper describes is just the beginning. The potential creativity in zoos and aquariums for creating interactive exhibits has only begun to be tapped. Together, using these techniques and others, we can and will reach all of our audience and help them become more aware of what a wonderous world time has given us, and the power we now hold collectively to destroy or save it.

And thus, in the spirit of sharing, this paper ends in a source list of 24 institutions with operating interactive exhibits. The individuals listed will be able to provide more in-depth information for the exhibits discussed.

IV. SOURCE LIST FOR FURTHER INFORMATION:

The author would like to thank each of the 14 institutions that sent slides, as well as Ed Bronkowski of the Cleveland Aquarium, Jon Coe and Gary Lee of Coe & Lee Associates, Ken Kawata of the Milwaukee Zoo and Bill Dennler and David Cooper of the Toledo Zoo for providing the visual information this paper is based on.

Before listing each institution, much interest has been expressed in the ICCE brass rubbing program. These brass plates cover a wide variety of endangered species and the Center also provides additional public literature. They work extremely well and can pay for themselves if a fee is assessed. At present, they are in usage at Toledo and Pueblo and can be obtained from:

The International Center for Conservation Education
Greenfield House, Guiting Power
Cheltenham Glos. GL54 5TZ United Kingdom

INTERACTIVE DISPLAYS AT 24 INSTITUTIONS

1. ARIZONA - SONORA DESERT MUSEUM, Route 9, Box 900, Tuscon, Arizona 85743
Phone: (602) 883-1380; Janis Hunter, Curator of Education.

Dissolve units, camouflage display, cat claw demonstration display, ultraviolet scorpion exhibit, stereoscopes with mechanical wheel, mine dump for visitor collecting and additional exhibits.

2. BRONX ZOO, 185th Street and Southern Boulevard, Bronx, New York 10460
Phone: (212) 220-5100; Richard Lattis, Chairman, Education; John Gwynne, Curator of Exhibits and Graphics.

Crawl-in snails, crawl-in turtles, crawl-in trees, crawl-up spider webs, amplified hearing with animal ears, pop-up viewing bubbles in exhibit, warm rocks by reptile exhibit, and additional exhibits.

3. CINCINNATI ZOO, 3400 Vine Street, Cincinnati, Ohio 45220
Phone: (513) 281-4701; Barry Wakeman, Curation of Education; Randi Mohn, Curator, Children's Zoo.

Insectarium: Sliding magnifiers, fixed magnifiers, weight scale giving equivalent weights in insects.

Children's Zoo: Underwater periscope, trap door spider exhibit, smell units, hidden animals for touch, pop-up viewing bubbles in exhibit, matching animal parts, and additional exhibits.

4. COYOTE POINT MUSEUM FOR ENVIRONMENTAL EDUCATION, Coyote Point Drive, San Mateo, California 94401, Phone: (415) 342-7755; Lori Mann, Education Director.

Excellent three-dimensional display on food pyramid, interactive mix and match unit on food chain and additional exhibits.

5. DALLAS ZOO, 621 East Clarendon Drive, Dallas, Texas 75203-2996
Phone: (214) 946-5155; Christine Seifert, Coordinator of Education.

"How do you measure up?", actual size graphic of zoo animals, weight scale with graphic and comparisons of other zoo animals and Galapagos tortoise shell for touch.

6. FORT WAYNE CHILDREN'S ZOO: Discovery Lab, 3411 Sherman Boulevard, Fort Wayne, Indiana 46808; Phone: (219) 482-4610; Cynthia Vernon, Curator of Education.

"Are you sense-able?" exhibit, including odor boxes, single-trace oscilloscope, with ear phones, stereoscope for looking at human hand and color vision charts. Also, imaginary animal print stamps, hidden object touch unit, and additional exhibits.

7. HONOLULU ZOO, 151 Kapahulu Ave., Queen Kapiocani Park, Honolulu, Hawaii 96815; Phone: (808) 923-4772; Rodolfo Valera, Graphics Designer.

Interactive graphics using turntables and lift doors, and turnable graphics matching up bird sections.

8. KALEIDOSCOPE, Hallmark Square, P.O. Box 437, Kansas City, MO 64141 Phone: (816) 274-8301; Regi Early, Director.

Touch activated handprints with sound, smell display, visitor construction of paper snakes and other animals, and many other creative interactive displays. (Although art-related, this institution has many concepts that could be adapted for zoos and aquariums.)

9. LINCOLN PARK ZOO, 2200 North Cannon Dr., Chicago, Illinois 60614 Phone: (312) 294-4649; Judith Kolar, Curator of Education.

Electronic graphic shifting from exterior to interior skeleton of dog and cat. Electronic graphic showing relative speeds of different animals.

10. LOUISVILLE ZOO: MetaZoo Education Center, Box 37250, Louisville, KY 40233 Phone: (502) 459-2181; Marcelle Guianelloni, Curator of Education; Nancy Scheldorf, Graphics Artist.

Simulated insect vision in giant "insect" head, illuminated elephant/human craniums, laminated Red Data book, microfiche viewer for ISIS, fixed magnifiers, sliding magnifiers, stereoscopes, micro-library, compound microscopes, take-home rubbings of zoo animal footprints, dual-trace oscilloscope with zoo animal sounds and additional exhibits.

11. MONTEREY BAY AQUARIUM: Kelp Lab, 886 Cannery Row, Monterey, CA 93940 Phone: (408) 649-6466; Steven Webster, Director of Education.

Stereoscopes, floating magnifiers, fixed magnifiers, current flow activated by visitor wheel, touch tanks and additional exhibits.

12. MSPCA (Formerly Macomber Farm), 450 Salem End Road, P.O. Box 2314, Farmingham Centre, MA 01701; Phone: (617) 879-5345; Judy Golden, Director of Education.

Simulated animal vision masks, animal stride exhibit on bridges, sound poles and additional exhibits. (Also, a number of computers, fiber optic devices, and other electronic exhibits no longer functioning.)

13. MYSTIC AQUARIUM, Mystic, CT 06355; Phone: (203) 536-4208; Kenneth Sherwood, Jr., Curator of Education.

"What is a fish?" exhibit: "How do fish see?" Viewing cylinders simulating double vision, wide-angle vision and downward vision. Also, viewing holes allowing children to imagine themselves as sea creatures, tactile boxes demonstrating fish scales, and children-created poems.

14. NATIONAL ZOO: Herp Lab, 3000 Connecticut Ave., N.W., Washington, D.C. 20008
Phone: (202) 673-4724; Judy White, Education Officer.

Pledge board on how visitor can help after hands-on experience with endangered species materials, construct reptile skeletons, parent-guided observations of living animals and additional exhibits.

15. ONTARIO SCIENCE CENTER, 770 Don Mills, M3C 1T3, Ontario, Canada
Phone: (416) 429-4100; Martha McGloin, Head of Public Relations.

Human grip testers, flexibility testers, vision testers, sound testers, stereoscopes and additional exhibits, many of which can be adapted to zoos and aquariums.

16. PLANET OCEAN, 3979 Rickenbacker Causeway, Miami, Florida 33149
Phone: (305) 361-5786; C.K. Worthington, Facilities Manager.

Artificial (but very real) iceberg open to public touch, television cameras simulating fish vision, wave generating tank and other exhibits.

17. PUEBLO ZOO: Discovery Center, 800 Goodnight Ave., Pueblo, Colorado 81005
Jonnene McFarland, Curator of Education.

Fixed magnifiers, sliding magnifiers, stereoscopes, heart display with pulse meter, ICCE brass rubbings, footprints, children's animal masks, "How do you measure up" comparison graphic, and additional exhibits. Outside, a hot/cold display with black/white painted concrete.

18. SAN DIEGO WILD ANIMAL PARK: Visitor Enhancement Program, Zoological Society of San Diego, P.O. Box 551, San Diego, CA 92112-0551
Phone: (619) 231-1515; Regi Harvey, Director of Education; Sydney Donohoe, Education Manager, Wild Animal Park.

Gorilla comparison graphic, fixed telescopes, gorilla rubbings of photographs, behind-the-scenes video monitor and additional exhibits in hear future.

19. SAN FRANCISCO ZOO: Primate Discovery Lab, Sloat Blvd. at the Pacific Ocean, San Francisco, CA 94132; Phone: (415) 661-2023; Margaret Burks, Executive Director, San Francisco Zoological Society.

Laser disc touch screen computers, primate hand and task comparisons, "Construct a Primate" mix and match unit, gorilla comparison graphic, scale for human/primate weight comparison, binocular depth tester and additional exhibits.

20. SEA WORLD OF OHIO, 1110 Sea World Dr., Aurora, Ohio 44202; Phone: (216) 562-8101; Pam Sears, Curator of Education; Raymond Patacca, Supervisor of Instructional Programs.

Coral animal, kelp and fish role-playing, coral polyp demonstration with multi-person hand-puppet like unit, dress-up costumes of marine mammals.

21. TOLEDO ZOO: Diversity of Life Exhibit, 2700 Broadway, Toledo, OH 43609 Phone: (419) 385-5721; David Jenkins, Coordinator, Museum of Natural Sciences; Steve Snyder, Exhibit Technician; Debbie Cooper, Education Coordinator.

Fixed magnifiers, sliding magnifiers, stereoscopes, with lazy susans, dual-trace oscilliscopes with pulse activated graphics, ICCE brass rubbings, footprints, animal masks for children, imaginary animal game for children and additional exhibits.

22. TORONTO ZOO, Box 280, West Hill, Toronto, Canada MlE 4R5; Phone: (416) 284-8181; Mary Beth Switzer, Curator of Education.

Children's zoo - human/animal jump comparison with sand pit, outdoor zoo animal tracks in beach.

23. TULSA ZOO, 5701 E. 36th St., No. Tulsa, Oklahoma 74115; Phone: (918) 835-8471; Tim Evanoff, Curator of Exhibits.

The "Mutascope," electronic push-button viewer of stop motion photography of a leaf bud opening. "Cave Element Identification," using 10 channel circuitry, activates both voice and spot lights to illuminate cave formations. "Mother Earth," a ceiling-mounted triggered talking head translates 100 million years into one human year and additional exhibits.

24. WASHINGTON PARK ZOO, 4001 S.W. Canyon Rd., Portland, Oregon 97221 Phone: (503) 226-1561; Jack Delaini, Education Director; Roger Yerke, Education Specialist.

Outdoor binocular vs. monocular vision/coordination tester, dinosaur garden, plant succession graphics, and additional exhibits.

Setting the Stage: The Marketing and Publicity Challenges of Opening the Monterey Bay Aquarium

by John C. Racanelli, Director of Marketing
and Hank Armstrong, Public Relations Manager

Our definition of marketing at the Monterey Bay Aquarium is to insure financial self-sufficiency and to foster a high quality public image for the institution. Annual attendance and revenue goals are met through programs in group sales, membership, development, business sponsorships, and selected advertising. The aquarium's image is maintained and augmented by carefully managed publicity/community relations efforts which support these programs.

I came on board in January 1984, ten months before the aquarium opened. I was charged with the task of meeting an attendance goal of one million people for our first year of operations. My first objective, therefore, was to set up an organizational scheme for the marketing department. As shown in figure one, our marketing staff is broken down into three basic subdivisions: group sales, membership and public relations. Each has a manager who operates somewhat autonomously and manages his or her own budget and staff. The total staff of the department is somewhere between thirteen and fifteen, depending on how many part-timers or volunteers we have working with us. We meet once a week to insure good communication. This scheme has worked very well for us.

Figure two shows the organizational plan we laid out in in February 1984. The first thing we did was put together a marketing plan that identified eight major areas of objectives: advertising and market research, charter membership, business sponsorship, group events, group sales, promotions, publicity and community relations, and finally the grand opening. We developed an extensive marketing plan focusing on each of these areas.

With only ten months to accomplish this plan, we set a timeline comprised of three basic functions (figure three). First, the research period, lasting from about February through May, was to research and investigate the various possibilities and opportunities available to us. The decision phase, May through July, was to decide upon rates, programs and policies. Implementation of these plans, the more difficult phase, started about July and continued into and through the opening.

RESEARCH PHASE

We had a lot to learn, so in the research period we established several elements that we wanted to accomplish:

1. learn about institution
2. define markets
3. assess comparable facilities
4. identify advertising/design options

Learning about the institution was first: the site, staff and background of the project. Another was to define our market, which we broke down into three basic areas shown on the map in figure four. An early study done in 1977 by Stanford Research Institute identified three market areas which we use today: the primary, secondary and tourist markets.

The primary market, which includes residents within a one hour drive time, represents about a half-million people; a relatively small home market. The secondary market, from one to two hour drive time, is substantially larger, however. Representing essentially the San Francisco Bay area, it includes about four million people. Finally, the tourist market represents everyone not included in the primary and secondary markets. The tourist market in Monterey has been variously identified to be about six to six-and-a-half million people per year.

In April of that year, we initiated a market research program in the secondary market to identify general perceptions, awareness of the aquarium (which at that time was virtually nil), and reactions to various concepts about the aquarium. We learned some very interesting things. One of them was that the idea of a kelp forest exhibit rated very low in popularity. That has since become the most important and popular element of our entire exhibit program, but I'll never forget the fellow in our focus study group who stood up and said, "Kelp forest! Who wants to sit around and look at a bunch of brown seaweed?"

Another objective area was to assess comparable facilities, and that meant calling around the country to determine various rate structures and programs for other aquariums and zoos. This provided valuable insight into how our objectives and programs measured up.

Finally, we assessed advertising and design options, anything from graphic materials to radio spots and public service announcements.

DECISION PHASE

We had a lot to decide, and we gave ourselves from May through July to make the necessary decisions:

1. set rates
2. hire staff
3. set media plan
4. set image standards
5. develop contingency advertising plan

The first and foremost was to establish our rates for admission, memberships and group events. We had that approved by the Board around June 1984 and that gave us something to go out and sell. Our staff hires and the their dates were set about that time as well. The first key staff member I brought on board was Hank Armstrong, our Public Relations Manager. His first task was to plan and implement a media publicity campaign.

The publicity effort began about five-and-a-half months before opening. We started by designing a promotional plan that took into account two things: the aquarium would be brand new only once, and pre-opening promotion meant publicizing a construction site.

That plan examined the target markets detailed earlier, then established priorities for approaching media within those markets. Attracting national media exposure came first. Next, maximum pre-opening coverage throughout the San Francisco Bay area; and finally, contacting the media with the longest lead time--such as annual tour books and national magazines--right away. That last insured everyone would have the opportunity to do a piece prior to or during the opening. That the aquarium would saturate the small local media market was assumed, so the emphasis there lay on building strong long-term relations rather than creating story opportunities during an extremely hectic period.

Setting policy for media on-site followed setting the priorities. All media contact with the aquarium was to come through the public relations office, less as an attempt to control coverage than to minimize disruption to busy staff whose first priority was completion of the project. A 24-hour notice prior to visits was asked when possible. And early on, any interviews with staff had to be attended by a public relations person.

BEST COPY AVAILABLE

A high awareness of portraying the proper image was maintained at all times. Education and research goals were continually stressed, as was the aquarium's non-profit status.

We had to very gingerly and carefully explain to various media people that, for their own safety, they couldn't go out on the site with anything but the heaviest boots and a hard hat. This meant watching a lot of stand ups done by TV commentators and reporters wearing borrowed field boots and fashionable evening dresses or suits. Needless to say, it was a humorous sight.

Another element of maintaining our image standards was strictly governing the use of our logo and name. The aquarium was gaining popularity and many were finding it auspicious to use or to want to use our name and logo on printed materials or in various media. Obviously that kind of exposure is generally good, but we had to be very careful that it was used in a manner that best befitted the aquarium.

In this phase we planned an advertising contingency schedule based on the publicity program. Should our desired publicity objectives not be met, we were prepared to augment that with radio, print and outdoor advertising.

IMPLEMENTATION PHASE

By this time we had a lot to do; hence the implementation period, which started in July and continued through the opening:

1. sales effort
2. charter membership campaign
3. media contact
4. community relations
5. grand opening
6. systems

We identified several areas of objectives, starting with the sales effort. Group visit and group event sales actually began in earnest in August. We met with bus tour operators, meeting planners, association executives, and hotel sales and management professionals. We set up our group reservation booking line and began taking bookings and really soliciting for group business.

Our Charter Membership effort began in July. We developed our materials and got a mailing out to all Monterey Peninsula households on September 1, roughly seven weeks before our opening. Response to that program was phenomenal. We are all familiar with the typical direct mail response of about one percent; we were very fortunate in that our response was about 27 percent! Much of it had to do with the growing anticipation of waiting six years for this institution to open. With 28,000 local residents, we drew about 7,500 memberships from that initial mailing (figure five).

From July through October we designed and produced 17 different graphic projects, everything from press kits to group sales collaterals to rack brochures. Our intent was to insure that those materials were befitting of the aquarium and of the highest quality.

In this period the media contact had built up to a "media feeding frenzy." Public relations faced an enviable problem, nonetheless. Intense media interest made the diffficulty not attracting publicity, but efficiently meeting demands for footage, photography, interviews, backup information and more.

The first project was to create a detailed press kit that answered most-asked questions. That kit combined with photographs provided the basis for the majority of stories.

A sophisticated media list also was assembled. The computer program allows for mailing to 15 different categories, including local and regional radio and TV, daily, weekly and free papers, tour and travel publications and a variety of others. Each publication or station was coded to receive certain types of mailings, the labels being generated by computer.

High quality photography that was made available to any media insured the story would receive maximum prominence and kept on-site visits by photographers to a minimum.

Those few images were crucial because plywood covered a good portion of the interior until just prior to opening.

We developed a few pre-opening publicity opportunities to raise awareness of the aquarium both locally and in the San Francisco Bay area. A champagne reception for the otters' arrival in their exhibit...the first aquarium guide touch pool training session...the arrival of the first sharks...all produced stories.

Good community relations were encouraged both through frequent attendance at municipal and local group meetings and the Speaker's Bureau. The latter not only met numerous requests for presentations, but involved aquarium guides while they were still in training, and gave them experience in speaking before audiences.

The other element of community relations that we undertook at that point was our Business Sponsorship program. We started out specifically offering only to local businesses the opportunity to become sponsors. This was an important factor. Although the Monterey area has some industry and business headquarters, it is dominated by the San Francisco Bay area. Before going to the corporate centers in San Francisco, however, we made a strong effort to insure we approached all the companies based in Monterey to give them a chance to get involved. Exhibit sponsorships and business memberships were very well received locally. Only afterwards did we go to the corporate people in San Francisco to pursue large exhibit sponsorships. By our opening we had about twelve exhibits or galleries under major sponsorship and it totaled about $250,000 in annual contributions. It has been a very successful program for us.

Our Grand Opening took a lot of planning time and we brought in two people from outside to help. We had to plan, coordinate and execute 13 different preview openings for everybody from the fishermen who helped catch our fish, to the travel industry, the media, the Charter Members, and others who had reason to see the aquarium before it opened.

Our marketing staff took a key role in developing our systems. The reservation system, which we developed in concert with Visitor Services and Education, is fully computerized. Though it works well for us, like all computer systems it had a lot of "bugs" and we did a lot of "bug-swatting" before getting the system fine-tuned.

Our membership data filing system was programmed to include a plethora of information, requiring four screens and about two minutes keypunching time per membership. Hence, when over 7,000 membership applications cascaded in over a two-week period, we found ourselves keypunching day and night to get them all on the system.

Our zip code tracking system has proven to be a valuable marketing tool. By retaining the home zip codes of our visitors it allows us to define our market mix with extreme accuracy. For example, immediately after we opened about 75 percent of our attendance was coming directly from the San Francisco Bay area. This was of concern to us in that we were drawing so strongly from one market and not pulling as well from others. Subsequently, we started to target our publicity efforts more towards the Southern California area. By summer's end, it had leveled off at 62 percent from Northern California and about 19 percent from Southern California, a well-balanced market mix.

FIRST YEAR RESULTS

We are all judged by our results and at the Monterey Bay Aquarium we have been fortunate to be able to report very good results to our Board in this first year.

The graph in figure six represents our attendance trends: projections versus actual attendance. Like all projections, ours had a logical and gradual progression to the summer months then an equally gradual tapering down in the fall. The actual results, however, which represent the real world, must be examined more closely to make sense of them.

We based our projections on several existing models, including similiar institutions and other attractions in the Monterey Bay area. Though we expected something of a first-year excitement factor, we were taken aback at the magnitude and duration of ours. The first six months show a disproportionate bulge which demonstrates the intense interest after our opening. It then begins to taper down and in the months of May through August it starts to follow a more traditional trend along with the projections, although at a higher volume. It is now in more of a declining mode, and we anticipate a 20 percent drop for year two. We know that the next three to five years are really going to be the challenge for us.

Our original projection was for one million people in our first year. It is still somewhat overwhelming to us that we will reach about 2.35 million people by the end of our first year of operations. This is certainly a large number of people to be interested in fish and "a bunch of brown seaweed!"

Market penetration is defined as the percentage of people drawn each year from each market area. We have watched ours closely in order to compare it to original projections (figure seven).

Original projections were for about 15 percent penetration in the local market, about 84,000 out of approximately a half-million people. We have since drawn about 39 percent or 217,000 people. Our local market penetration rate has been extremely strong.

The secondary market, which is in the one to two hour drive time, encompasses about four million people. Our projected penetration was five percent, or 203,000; the actual has been about 16 percent, or 640,000 people. One of the single largest areas of increase, this has had a lot to do with our upsurge in attendance.

Completion of a detailed press kit, graphics, good photography and an effective media list for press release mailings prior to opening would have elevated interest even earlier.

The public relations effort was forced into a defensive posture early without this detailed preparation. Meeting all media demands proved time-consuming and hindered efforts to generate as much national publicity as possible.

The public relations coordinator came on a month after opening; that hire date should have been months earlier. In-house production of all marketing collateral combined with the constant demand for site tours before opening meant an inefficient use of time. Handling of site tours by media and others became close to a full-time position. Tours and writing/materials production are not very compatible job functions.

Although our charter membership went very well, we would have preferred more time between the various stages: from writer to designer, printer, and mail house. The timing on ours was good but more planning time would have been better. Also, we wanted a personalized mailing, to make sure that it was sent to a named individual and not just to "head of household." To do so, we purchased a commercial list with individual names taken from telephone listings and voter registration. Unfortunately, as any of you involved in direct mail probably know, these lists get old quickly; in our case the list was only about a month-and-a-half old and already 3500 names were invalid. Those pieces all came back to us in large boxes. All we needed to do differently was to put the three simple words "OR CURRENT RESIDENT" on the mailing label.

We might have planned more for growth in our programs and systems: most notably our membership data filing system. It was designed potentially for a membership of 10,000 memberships, which we exceeded by more than three hundred percent. As we mentioned, it was too time-consuming and should have been a more streamlined program.

Our last advice: gird for response. There is a saying that anything done right will do well. We are true believers in that adage today; a year ago, however, we were unwilling to base our plans on such high expectations.

Being marketing professionals, it is essentially our duty to "expect the worst, strive for the best." But when involved in a major opening of any kind, this principle is flawed. One cannot be over-prepared for the potential response to a new, high-quality institution; just as we, the National Aquarium in Baltimore, and several others in recent years have not been.

BEST COPY AVAILABLE

In the tourist market our penetration was projected to be 12 percent (approximately 780,000 people). We've actually drawn about 20 percent, or almost 1.3 million. The number of people who visit Monterey as tourists each year is open to conjecture so we could conceivably be drawing a higher or lower percentage. We plan work with our Convention and Visitors Bureau to clarify those numbers in years to come.

Publicity and media attention have been very strong and very positive, but you can only do stories about the opening of the aquarium once. Our focus now is turning to specific story angles as the newness wears off and the aquarium matures: research projects, education programs, new exhibits, etc.

Our membership today numbers 37,000, which represents 105,000 Charter Members of the Monterey Bay Aquarium. That makes us the second largest zoological/aquarium society in the nation. At this point we are going into our first renewal program and are projecting about a 70 percent return rate.

Before we opened, we had originally set a goal of 70 evening group events each year. As it turns out, we will have hosted about 200 events the first year, an event every other night. This has become a very large revenue source for us, as it allows us to use the aquarium at times when it is not otherwise in use. I strongly recommend developing a group events program to each of you who has a facility or space that you can use.

CONCLUSIONS

In retrospect, there are things that we might have done differently. First would be to throw out all the feasibility studies. At the very least, one needs to use feasibility studies with caution. We found that the data in ours, calculated in 1977, was old and somewhat "stale." This meant that any projections based upon that original study were colored by assumptions and models that were set seven years before our opening. Unless you plan to update them each year, which can be very costly and time-consuming, we suggest using feasibility studies only as a broad guideline. Whether they are overambitious or underambitious they generally tend to lead to problems in projecting and proper planning.

Another vital point is to begin the marketing effort earlier and give yourself more time. This applies to staff, budgeting and certainly to the media plan. Starting earlier and being more fully prepared for the avalanche of media interest that occurred would have allowed us to take more total advantage of the opportunities for publicizing the aquarium that did occur.

New technologies and enlightened management have brought us a new generation of zoos and aquariums. It is our ongoing challenge, then, to interpret these institutions to the public and insure their future success.

FIGURE ONE

ORGANIZATIONAL CHART

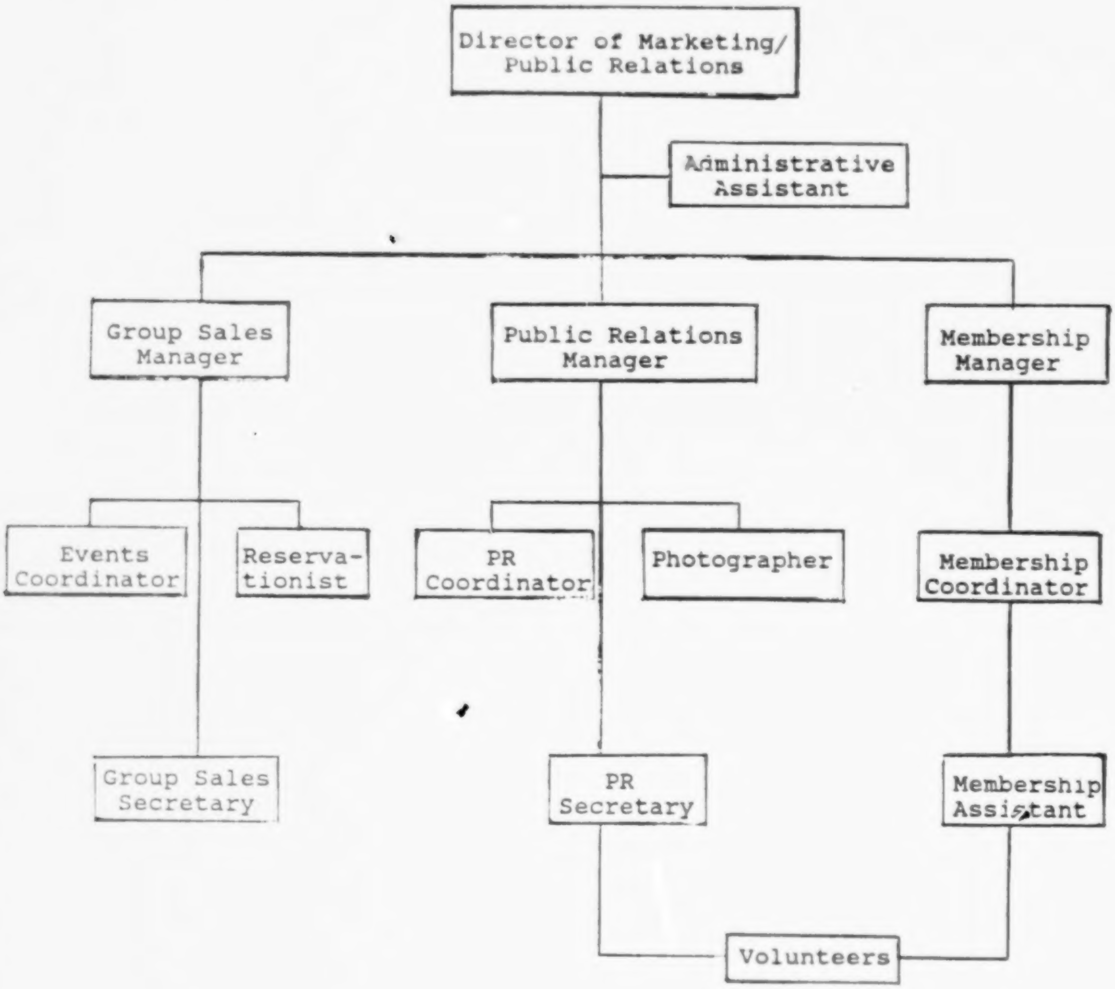
Director of Marketing/ Public Relations
Administrative Assistant
Group Sales Manager
Public Relations Manager
Membership Manager
Events Coordinator
Reservationist
PR Coordinator
Photographer
Membership Coordinator
Group Sales Secretary
PR Secretary
Membership Assistant
Volunteers

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FIGURE TWO

MARKETING PLAN OUTLINE

I. ADVERTISING/MARKET RESEARCH

II. CHARTER MEMBERSHIP

III. BUSINESS SPONSORSHIP

IV. GROUP EVENTS

V. GROUP SALES

VI. PROMOTIONS

VII. PUBLICITY/COMMUNITY RELATIONS

VIII. GRAND OPENING

FIGURE THREE

PRE-OPENING TIMELINE

(THREE PHASES)

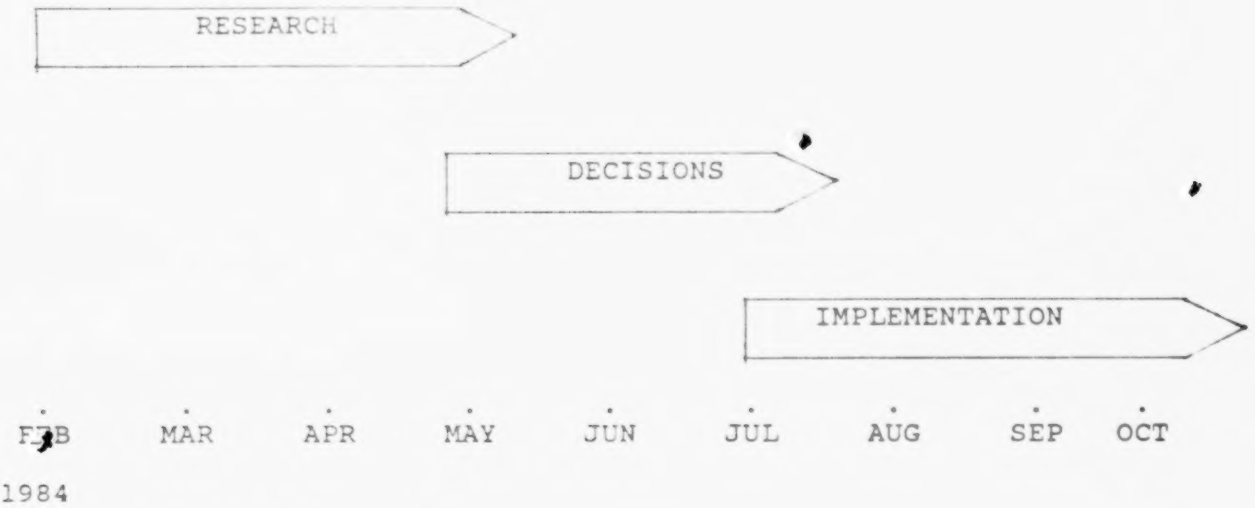

RESEARCH
DECISIONS
IMPLEMENTATION
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
1984

FIGURE FOUR

DEFINITIONS OF MARKETS

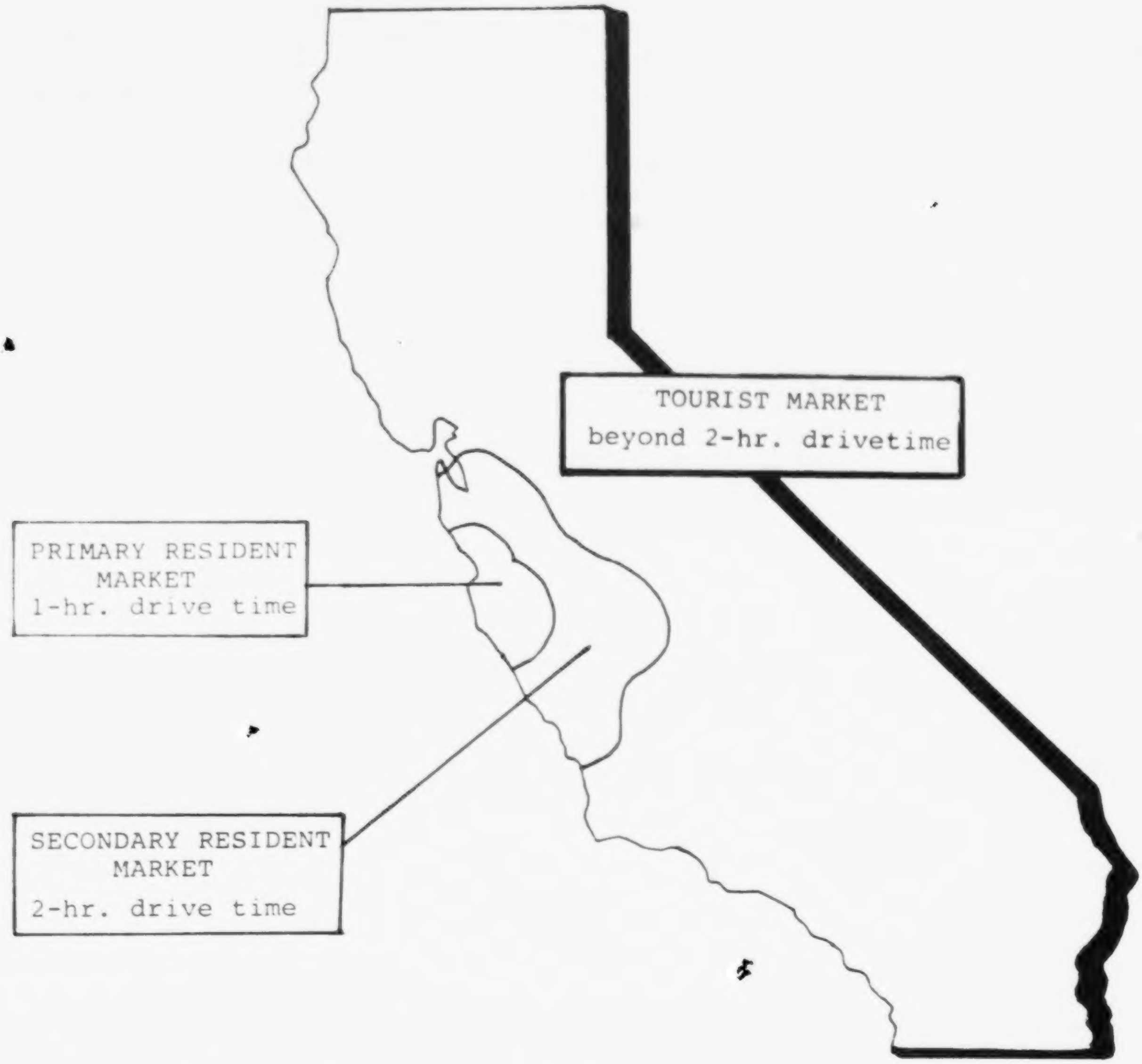

TOURIST MARKET
beyond 2-hr. drivetime
PRIMARY RESIDENT MARKET
1-hr. drive time
SECONDARY RESIDENT MARKET
2-hr. drive time

FIGURE FIVE

CHARTER MEMBERSHIP
DIRECT MAIL
CAMPAIGN

(AUG-SEPT 1984)

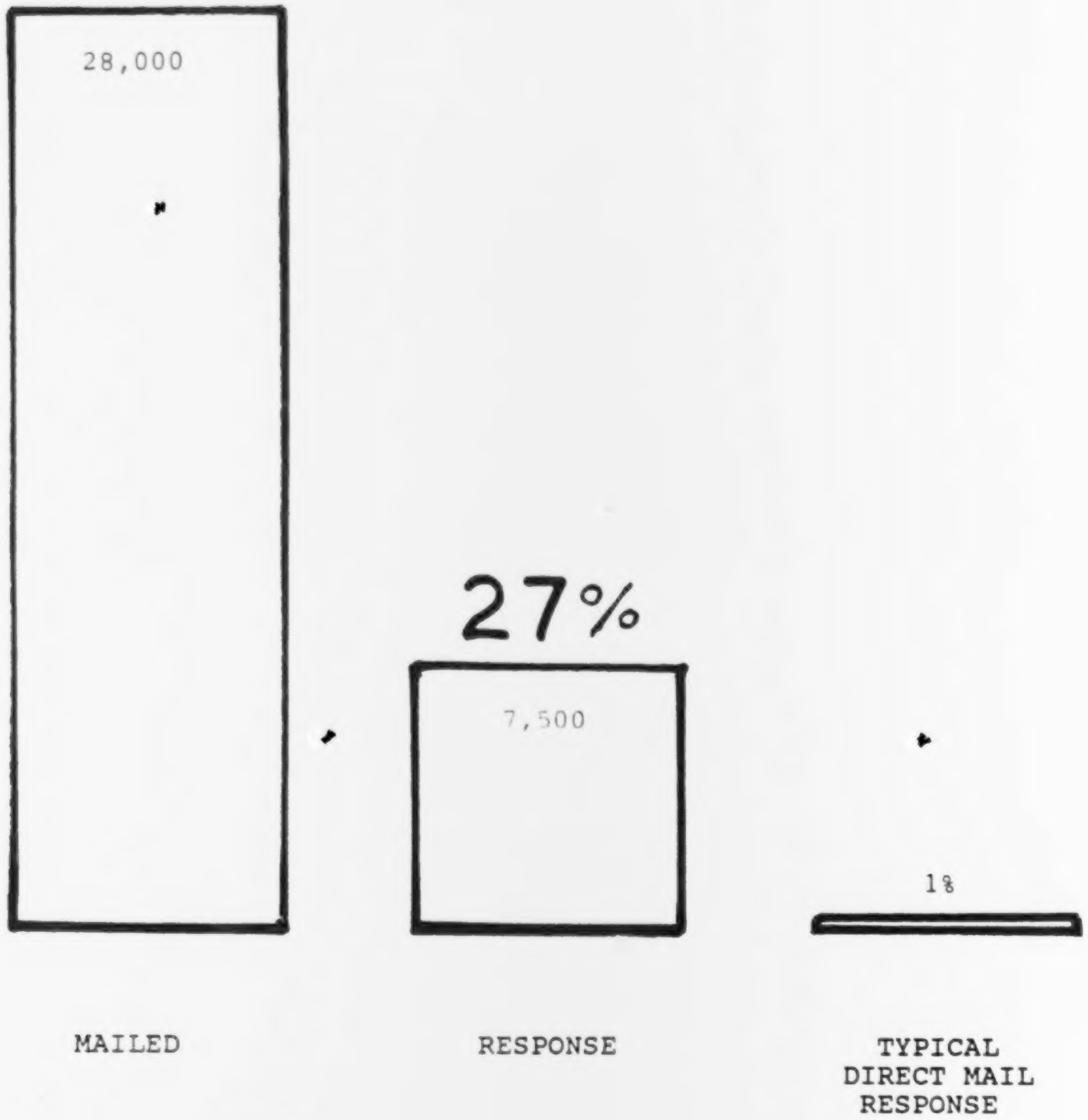
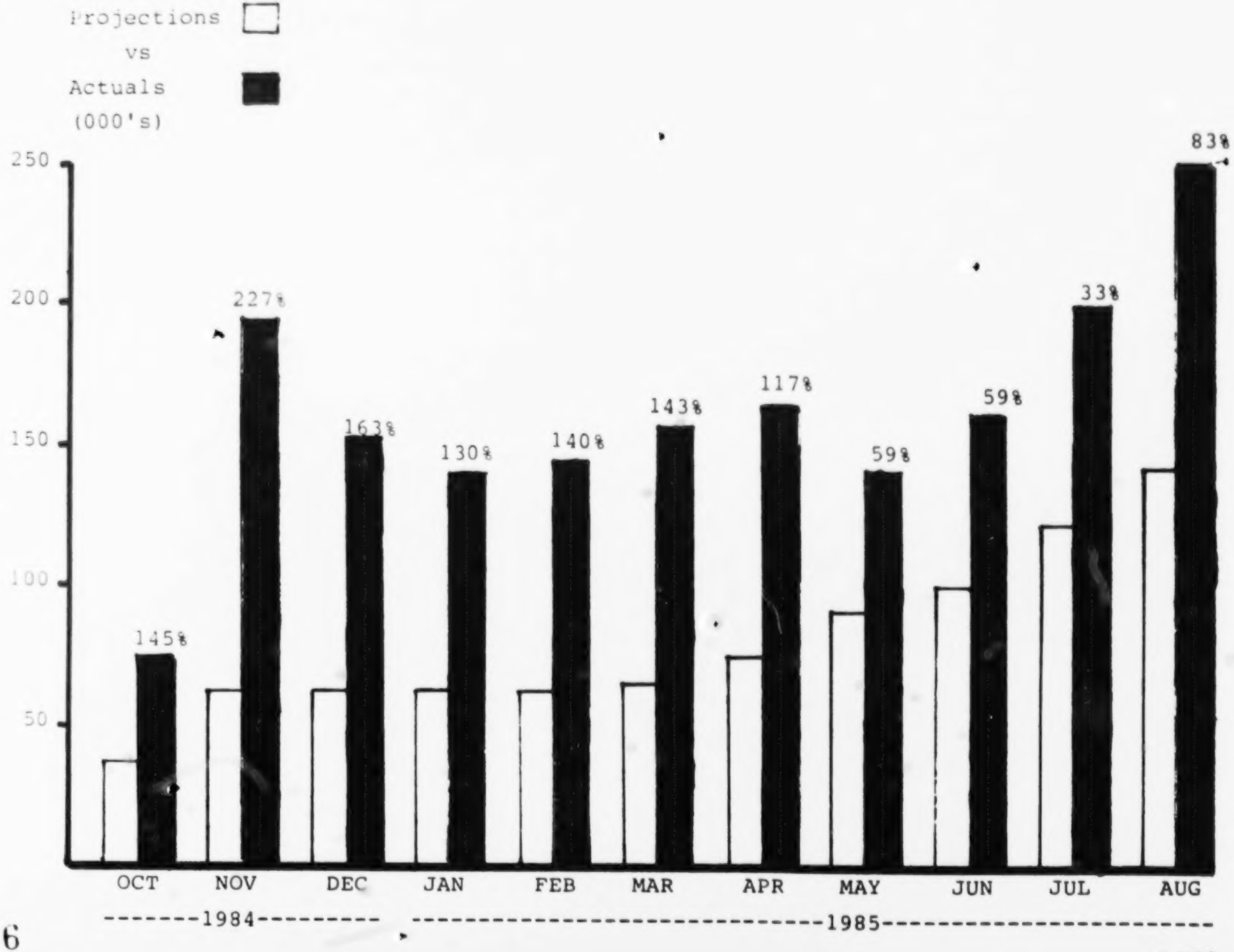


FIGURE SIX
MONTHLY ATTENDANCE

FIRST 11 MONTHS



Membership Development

Chip Weigand
Director of Membership
and Special Projects
Audubon Park & Zoological
Garden
New Orleans, Louisiana

Whether you come from a large zoo or a small zoo, an old zoo, new zoo or a zoo on the brink of renovation, a membership organization can be a valuable asset for several reasons. And, the principles necessary to operate a successful membership organization are the same for all zoos, large or small, even though the methods of application and financial resources available will vary.

Before talking about specific membership questions. I want to make two points, at the risk of seeming pedantic.

First is the importance of your zoo placing a high priority on membership development. Too often membership departments and societies, especially at smaller zoos, are not held highly by the zoo's top administrators or governing body. But membership societies can be as important to the overall success of your zoo as any other department. Of course, the first reason is money. Memberships should produce a surplus for the zoo's operation and improvement. I believe this surplus should be between 50 and 60 percent of membership income for an organization placing heavy emphasis on growth.

But there are other reasons.

Membership income is more fixed than other forms of income and can be budgeted better.

Membership income can and generally does come mostly in the first half of the calendar year, so it can be used to smooth over slack times.

Membership socializes future generations into feeling that the zoo is a part of their lives. The children of current members will be more likely to contribute later to the zoo's long term survival.

Although members generally get in free, our studies show that they visit 3 times as often as non-members and spend equally on each visit as non-members for food, beverages, and souvenirs.

Your membership organization is a political force also. Members are not only donors, but are also voters. Their support can be elicited for appropriations by state legislatures or city councils for your zoo. We have recently conducted a successful postcard writing campaign with Audubon Zoo members on behalf of a state appropriation.

Membership organizations, although mainly consisting of low donors, can also identify and develop those who can become high donors. I don't want to belabor the point, but you can see that I believe that membership development should be a high priority in any successful and forward looking zoo.

Secondly, but related to this, a membership department or society should be viewed by the zoo's administrators as an intrinsic part of the organization. Coordination between the membership person or staff and the rest of the zoo should take place at all levels, whether planning for a capital campaign or for a special event. All promotions, whether involving posters, publications, advertising, gift shops and so on, should include consideration of the membership angle. Even the physical facility planning should at least consider membership needs, whether for a special members entrance (which we at Audubon have found highly successful), or for a members area at the zoo, or for the office space needs of membership equipment and personnel.

At the risk of being too commercial, it can be said that a zoo must be marketed, much like any other product. Marketing takes a comprehensive look at all aspects of the product. And membership is an important tool whose use should be maximized in achieving the zoo's overall goals.

Now I want to explore 5 questions about membership development, and use some of our survey results to try to give the answers.

I. Who joins a zoo?

II. Why do they join?

III. How can we structure our membership categories, prices, and benefits so as to gain the most income?

IV. How can we keep the members after they've joined?

V. How can we get them back if they let their memberships lapse?

There is another important question which I won't get into here, but which certainly deserves equal consideration, "How can we get the most additional funds, other than basic dues, from our members?"

I. Who joins a zoo?

(Let me add a proviso about the marketing survey results I'll be giving on these questions. Although I've tried to generalize them, they apply to Audubon Zoo and there may be differences for you depending on your community, pricing structure, and your zoo itself.

The primary characteristics which we have found to identify our members versus non-members are: family status, income, and place of residence.

Zoo members tend to be families and to visit the zoo in parties of 3 or more. While half the non-member visitors are in parties of 3 or more, 2/3's of the members are.

While 36% of our member visitors come with children aged 12 and under, only 26% of non-members do so.

Overall, 64% of members call their visit a family outing, while only 46% of non-members do so. Re-inforcing this is the fact that lapsed members tend to have less children than those who stay in the organization.

While all of these figures indicate what we might have guessed, that zoo members tend to be families, there were some other results which were significant, especially if we want to reach the widest possible audience with memberships and have categories to fit them.

First is that 12% of our member visitors were the single parent and child, a figure that seems to be rising annually. Only 7% of non-members were in this category, so it appears that zoo membership can provide an increasingly attractive form of recreation for the single parent.

Secondly, 16% of our member visitors were parties of adults, half of them couples on dates. Although this compares with 36% for non-member parties of adults, it does indicate that a significant sub-market for memberships can be found among adults without children. To complete the picture, 7% of member visitors were adults alone, showing that the individual membership is still popular.

For comparison, and, perhaps, to help project revenues and sales, here is the breakdown of what percentages of our memberships are in these categories: Individual memberships account for 15%, the 4 categories which apply to families account for 72%; and our new Dual category, for a member and his/her guest, so far accounts for 7% and has shown fast growth. After family status, another characteristic of members is income. As one might also guess, members tend to have more household income than non-members. While 49% of non-member visitors had household incomes of over $25,000, 64% of member visitors did so. Of course, this information should be used in selecting media for advertising and, especially, in selecting lists to be rented for use in direct mail solicitation.

However, we have discovered another factor related to this as our membership has grown. The earlier members tend to have larger incomes than the late joiners. Those of you from larger organizations may want to adjust your focus slightly on new member acquisition drives. But those from smaller societies should concentrate your initial promotional resources on the upscale market.

It also follows from this, and has been shown by another survey, that members with lower incomes tend to let their memberships lapse more often. Hence, offers of a discount tend to work better on lapsed member appeals, which we will get into later.

The third characteristic of members is place of residence. There are only 3 simple points to make here:

1. The closer one lives to the zoo, the more likely he or she is to join, other factors aside.

2. The exceptions to the above are selected higher income suburban areas, which can be targeted separately for advertising and direct mail appeals usually by using zip codes.

3. The outer, or ex-urban areas of a city, while they will produce members, generally will not have the population density of potential members to justify advertising or direct mail.

We have found other characteristics of members, but which are of lesser significance and which are not as susceptible to targeted marketing. For example, age. Members generally tend to be older than non-members, especially in the 45-65 age range. However, members over 45 tend to drop out more, perhaps because their children have grown up. Also, as the organization gets larger, new members tend to be younger than early joiners. This might be helpful in compiling list selection for large societies.

II. The Second major question is: "Why do they join?"

Our research shows that there are really only 2 reasons why people join a zoo organization.

One is cost versus benefit, the economic reason. Basically, people figure out whether they get their money's worth by joining versus individual, paid visits to the zoo. The other reason is the altruistic one, the "good feeling" they get from helping to support the zoo and feeling like a part of it.

In our surveys, 95% of the members randomly contacted by telephone gave these 2 reasons as theirs for joining in an open ended question. Virtually insignificant were factors such as free admission to special events, the exclusive members gate, discounts at the gift shop, the reciprocal zoo priviledge, or the tax deductibility of dues. This does not mean that these other factors are not important for other reasons, such as keeping them as renewing members. In fact, other studies have shown that. But the reasons for getting them to join at first are altruistic and economic.

Although we can separate these 2 reasons logically, they are quite hard to separate in actual marketing practices. Here's what we do at Audubon.

First, we emphasize the cost-benefit factor-"See Audubon Zoo Free anytime." We assume that the more altruistically motivated people don't have to be told too much about the importance of their help, but that the cost/benefit minded potential members need to be reminded of the good financial sense of the decision to join.

However, we never emphasize only the economic motivation. Even thrifty people want to feel like they are helping a worthwhile cause. In our advertising, signs, direct mail appeals, we always include the fact that their dues help support our fine facility and our wildlife conservation efforts. Thus the signs at the zoo which are headlined "See Audubon Zoo free anytime" also say "Be a friend to the Audubon animals."

Let me throw in 2 more minor points. First, as a hint to those of you who write direct mail copy, is that the same study showed that members acquired through that means are more altruistically motivated than those who join at the zoo itself. Also, the newer members of a large organization tend to be more cost/benefit minded than the earlier joiners.

III. The third question I will address here is "How can we structure categories, prices, and benefits to gain the most funds?"

First, categories.

If you already have a special low priced student or senior citizen membership, you probably cannot drop it. But if your organization is small or new and has growth potential, I would suggest not including these 2 categories. We have found that students are not easy to recruit, that the membership invites cheating and definitional problems. Senior citizens do not visit the zoo often. They make up only a minute percentage of our total visitation and are probably better served by a discount admission. In any case, if you have these categories, don't advertise them, especially in direct mail. They add needless clutter to your brochures, signs, and mailings, while generating little income.

Next, consider some type of Dual, or "Companion" membership. There is a growing market of what might be called non-traditional family groupings. This membership solves problems, but can also be used to upgrade an individual membership so that the former individual member may now bring a date or friend.

Your family membership is the cornerstone category and probably always will be. I strongly suggest that you define it within strict limits--say exactly what constitutes a family--and put that definition clearly in all your printings. And on the membership card itself.

For the upgrade memberships, those above family, the cost/benefit versus altruistic spectrum comes into play again. People who join at $100 or more are generally not counting their benefits in terms of dollars, although some extra benefit should be given.

However, what about the middle range--above family but below generous donor status? At Audubon, where our Family membership costs $40, we have created the Family-PLUS membership at $60 to hit that somewhat upscale market of people who want to contribute a bit more, but want to get something for it. The Family-PLUS members can bring in one guest on their visits and receive a gold colored plastic card as a sign of special status. This membership is mainly an upgrade mechanism, to get existing family members to increase their dues.

Above $100, I would suggest caution in creating additional membership categories. They are purchased by few and clutter up your brochures with needless printing. There are other ways to recognize the larger donors, such as donor clubs, than creating membership categories.

Finally, we have just started a specially designed membership category for businesses, the Curator Club.

On Prices.

We have covered some of this, but I would add 2 suggestions. Price your dual membership the same as your basic family one. Singles can generally afford it and you don't want existing family members without children to downgrade their membership to save money. Second, calculate your membership prices based upon the general admission rate at a ratio of about 2 1/2 times a typical family's paid admission for a family membership. We have seen a very exact correlation between the number of visits a members makes and their decision to join or stay in the organization.

Lastly on prices, watch the first digit carefully when you raise dues. Our research indicates that it might be more profitable to raise dues from, say, $25 to $35 rather than to $30 because more people drop off when they see that first digit go from 2 to 3 or from 3 to 4 than seem to notice the second digit as a $5. This is not an absolute rule, but something to consider when raising dues.

On Benefits.

As was noted before, people do not join the zoo for the benefits, except for the free admission privilege. The other benefits, however, can help you retain members. Thus, the members perception of the importance or value of the benefits you might provide should be the key factor in deciding which benefits to provide and how to promote these benefits to your members. The order in which you list benefits on membership applications, posters, mailings and signs should be carefully considered. Graphic prominence should be given to those benefits held most valuable. In one study, our interviewers read each membership benefit one by one and asked the member to rate the importance of that benefit to him or her.

In the results, first, of course, was the unlimited free admission benefit, with 78% terming that "very important."

Next, to our surprise, was the special members gate with a response of 66%. We now operate the members gate 7 days per week having started it on weekends only. It is not only a benefit to members, but produces a profitable income through membership sales, even during weekdays.

Far lower on the list in response, but still quite significant with 44% calling it important is"Zoobilation (which is our members only evening at the zoo) and other special events." New members rated this choice even higher, showing that special events can be a membership inducement.

46% rated our quarterly color magazine, AtTheZoo as very important.

Another surprise was that 40% called the reciprocal zoo priviledge a very important benefit.

Here I would like to add a note of my own encouraging all zoos to join the reciprocal zoo list. Even though New Orleans is a tourist destination and presumably our zoo might have more to lose by offering free admission to other zoo's members, we have consistantly found that the benefit outways the risk. Encouraging zoo attendance ultimately works to all our benefit, I believe.

Finally, on the list, came the discount for members at our zoo's gift shops, with only 25% calling that very important.

That's the way our members rate our benefits. You may well want to have your members rate your benefits, especially the ones not covered, such as free parking, free or discounted admission to certain areas of your zoo, or free rides on monorails, trains, elephants and so on.

IV. The next to last question is:

"How can we keep them as members?" or "What type of renewal program should we have?"

I believe the major point to remember here is that your renewal program does not only consist of the notices you mail out near the membership expiration. It consists of everything you and your zoo do from the moment you receive the first dues check. Prompt, accurate processing of the membership is essential. Consistantly calling attention to your membership benefits in your members newsletters and magazines is important. Thanking your members often helps. And, consistently pointing out future attractions can keep members interested in remaining members.

As for the renewal notice system itself, we are in the process of changing ours, so I don't have any direct results yet. However, the great majority of our members respond to the first notice we send. A survey showed that 80% of them said they consider renewing their membership an "automatic thing." Although I suspect they exaggerated a bit, we are using this data to develop an inexpensive early renewal notice. This is to get the "automatic renewers," our "best friends," to send in their dues early, perhaps 4 to 5 months before expiration, and at a lower cost to us. Then, for those who hold out, we will send more colorful and slightly more costly notices nearer their expiration date and an even more attention getting notice just after they've allowed their membership to expire. In this way we hope to direct renewal program expenses to where they can be most effective.

V. But this brings up the last question: "How can we get them back after they've let their membership expire?"

We did a special survey on this and some of the answers were somewhat surprising. First it was thought that people moving away or getting divorced would account for the bulk of the dropouts. We found that 31% of the lapsed members over a 5 year period had moved out of town. Only 1% listed change in marital status as a reason for not rejoining. That left 68% still available to us. They split evenly among these three reasons for not renewing.

1. They "never got around to it;"
2. The cost of membership was too high; and
3. They didn't go often enough to justify the expense.

The surprise was that almost one third of the lapsed members were not lapsed in their own mind. They just hadn't yet renewed. Their psychological connection to the zoo had not been broken.

My suggestion, then, is to keep mailing and mailing to your lapsed member list. Keep track of the percentage of returns by how long ago they have expired and stop mailing only when this rate falls below your new member acquisition rate if you do direct mail. Otherwise, keep track of the costs of your lapsed member mailings versus the income according to how long the membership has expired.

At Audubon, we have found it profitable to send mailings to members as long as three years after the expiration date.

But, what brings back a lapsed member? What can you say in these mailings:

The study and test mailings indicated that the most successful ploy was a $5 discount to rejoin. Think about it. It usually costs more than $5 in advertising or direct mail expenses to acquire a new member. And, if an existing member complains that he, too, should get the discount, give it to him. In our experience this has only happened twice in three years, costing us only $10. This ploy is easier to work when you are raising dues and can offer lapsed members the old rate to rejoin.

Second, as an inducement to rejoin, was the dual membership. Having this more flexible membership appealed to about 38% of those lapsed members surveyed.

Other items on the list of inducements to rejoin, in order of the importance the lapsed member placed on them were,

-New exhibits at the zoo,

-Special musical events free to members,

-The special members entrance,
and

-New animal births.

That takes us briefly through the process from getting members to keeping them. Please don't hesitate to call or write if you want further information.

RENOVATING AN AQUARIUM ON A SHOESTRING BUDGET?

C. Jerry Wallace, General Curator
Toledo Zoo

(Slide 1) The Toledo Zoo, located in west-central Toledo next to the Maumee River, is situated on 29 acres of land. (Slide 2) Although small, we pride ourselves on being a complete zoo, having not only buildings for birds, mammals, reptiles, and fish but also a museum and greenhouse.

Here's a picture of our two story museum which houses both permanent and traveling natural history displays. Included in the building is a five hundred seat theater with full sound and lighting systems and dressing rooms, plus classrooms, offices and a new Diversity of Life display with hands-on exhibits. (Slide 3) Outside the museum a band shell and 5000 seat amphitheater provide facilities for many concerts and civic projects.

(Slide 4) A large greenhouse with two 100 x 50 foot growing houses provides plants for grounds and cage displays. (Slide 5) An arboretum open to the public is a pleasant area to visit winter or summer.

(Slide 6) On April 1, 1982 the city turned over control of the zoo to the Toledo Zoological Society. With this new administration came a new, highly trained staff hungry to work with the animal collection. With a change-over of 90% in curatorial staff, keepers and veterinary staff came new methods and challenges such as working with electric eels. (Slide 7)

(Slide 8) This hand-carved sign at the entrance to the aquarium typifies the craftmanship put into the building which was dedicated in May, 1939. (Slide 9) The brick and stone building is 150 x 75' providing 30,000 square feet of display and visitor space. It was made from recycled bricks from a local school, limestone from the Erie Canal, and wood from local forests. Walls are 18-22" thick with railroad track used for reinforcement in the concrete floors. The building houses 41 display tansk from 500 gallons to 8000 gallons.

(Slide 10) Renovation started in April, 1982 but not before the large basement was emptied of 28 truckloads of junk which had accumulated over the years. This renovation was carried out by the regular staff of two full time and one half time keeper. All cleaning, feeding, husbandry and display work is performed by them. The title of this paper is somewhat tongue-in-cheek. We put in a lot of money but we did the renovation in house and could not have done it any other way.

(Slide 11) Our only air system was this compressor for a few forty gallon tanks. It was one of the first things we had to update.

(Slide 12) For those of you familiar with the Shedd Aquarium, some of this may look familiar. The aquarium was designed after the Shedd and incorporated many of its features such as the pumps from a reservoir to an upstairs gravity feed tank. (Slide 13) Five reservoirs totaling 225,000 gallons provide salt-water mixing facilities plus warm and cold fresh-water systems. Water came from the tank to the (Slide 14) display tank, overflowed to a (Slide 15) sand and gravel filter in the basement and to a collecting reservoir.

(Slide 16) All tanks were pool green with little or no decoration. (Slide 17) Galleries and tanks were lit with incandesent lights. (Slide 18) with little or no graphics (some of which the public corrected).

(Slide 19) A bare rock trout stream innovative in 1939 was now in poor working order and boring.

(Slide 20) Any construction usually follows many steps changing dramatically from what you planned to what you wanted to what you finally get. (Slide 21) Our first need was an air system to provide the start for individual tank biofiltration. (Slide22) Next we converted a fresh-water reservoir into a salt-water mixing tank. (Slide 23) This large glass tank is filled with the salt-water chemicals. Water is then pumped into the tank and overflows into the reservoir providing a very adequate mixing chamber. In this way we can make 22,000 gallons of synthetic salt-water at a time.

(Slide 25) One of the two repairs not done in-house was a new rubber membrane roof with Kalwall skylights. (Slide 26) The skylights were added to provide better color lighting for the fish and the possibility of plant growth in the displays.

(Slide 27) Disaster Thanksgiving Day 1982. A fire of unknown origin broke out behind our 9000 gallon South American tank. (Slide 28) Most of the fish in that tank died; the biggest loss was a four foot arapaima. However, this did inspire us to work even harder. Most of the physical damage was due to smoke and the loss of some plants. (Slide 29) Naturally our next addition was a fire alarm system. (Slide 30) We had just started to install a new elecyrical system (Slide 31) and fortunately it was not too far along in construction. (Slide 32) A generator for all bio-systems, heat and lighting provides a welcome margin of safety in case of power failure. All electrical outlets (Slide 33) are ground fault interrupted to protect all aquarium personnel.

(Slide 34) The building is so large that an intercom system was added.

(Slide 35) All the tanks had to be reglazed and painted. (Slide 36) We even brought in our own tools since maintenance couldn't give us their tools full time.

(Slide 37) Rainbow Plastic Portable filters provide good external filtration or fast emptying of tanks when needed. (Slides 38 & 39) We make our own underground filters from 2½" PVC.

(Slide 40) Acrylic sheets are added to the tanks to provide varied colors and rounded corners giving a changed depth of field viewing for the visitor. (Slide 41) For tanks with smaller fish the acrylic sheets can make the tanks smaller bringing the fish closer to the public.

(Slide 42) We now make our own fiberglass decor and are in the process of adding it as time allows. (Slide 43) Since tools for large aquaria are not readily purchased we made our own using PVC. They are strong, functional, non-corrosive, and inexpensive.

(Slide 44) In order to vary displays some were made half level with much use of plants from our greenhouse. (Slide 45) Many tanks did not have covers to keep jumping fish in, so a local net maker provided us with this escape barrier.

(Slide 46) Our trout stream was stark to say the least and in much need of repair since it was losing 1000 gallons of water a day to who knows where. (Slide 47) A change to a Japanese Koi Stream and (Slide 48) Garden gave us a chance to talk about aquaculture which has been going on for hundreds of years. Also we could add Mandarin ducks and Pekin robins. The area was not handicapped accessible so we added a deck that extends out into the area. (Slide 49) Plastic chain is in the doorways to keep the birds in, but it doesn't keep the visitors out.

(Slide 50) Our filtration doesn't allow large bio-load so we have made our own filters with bio-rings and small pumps greatly increasing our display tank capacities.

(Slide 51) Special lighting is provided for some reptiles and invertebrates.

(Slide 52) A cave fish tank with mirrors provides a pleasing but deceptive display.

(Slide 53) Too often visitors leave an aquarium with the feeling they have been excluded. We cut the glass in half on this rain forest tank to allow for sensory stimulation. (Slide 54) A PVC duct system provides rain, strobes provide lightning, and recordings provide thunder all via (Slide 55) a sophisticated timer.

(Slide 56) For the first time large salt-water fish could be displayed at the zoo.

(slide 57) Now that life support systems and displays were going we could concentrate on graphics including back-lit signage.

(Slide 58) A library was a must so we set about to establish one in the aquarium separate from the zoo's main library in the museum.

(Slide 59) Several donations allowed us to build a Diversity of Aquatic Life room where we display smaller fish and invertebrates, amphibians and sea turtles. (Slide 60 & 61) One of the more popular displays is the one housing mudskippers.

(Slide 62) A donation in May of 1985 allowed us to enlarge a tank for lemon sharks. We had to do it ourselves.(Slide 63) Pumping concrete is not an easy job. (Slide 64) The tank was doubled in depth to eight feet. (Slide 65) The extra height required a catwalk to be added. (Slide 66) At this time we have lemon, wobbegong, nurse, leopard, and black tip sharks on display.

(Slide 67) One problem we had was too many 500 gallon tanks, so we received a grant from Ohio Department of Natural Resources to enlarge several tanks into one for a lake sturgeon display. (Slides 68 & 69) A local bank also contributed and graphics with video displays were added. (Slide 70) The video unit was designed by a local engineering company and provided to us at cost.

(Slide 71) A major undertaking by the aquarium staff was back-lit graphics. All new sign holders were made, text was written, photos were made, and installation was completed in three months. (Slide 72) Donations have given us displays we would have had to wait years for; (Slide 73) leopard sharks, giant Pacific octopus, and (Slide 74) nautilus.

(Slide 75) Our last major problem is that we have very few small reserve tanks but the aquarium staff feels they can make some by the summer of 1986.

(Slide 76) The last very expensive change was to get rid of old asbestos insulation and as of this week that job has been completed.

The renovation was not cheap and it was not done cheaply, but it was done in house and couldn't have been done any other way with the monies we had allocated. (Slide 77) Jeff Cook finally sat down for a break after three years of fast and furious changes.

PRELIMINARY FINDINGS ON HEAVY METALS IN SALTWATER SYSTEMS FROM MONEL AND ALUMINUM FITTINGS

Roger Klocek
Shedd Aquarium
Chicago, Illinois

Long term problems in culturing some invertebrates in the Aquarium's salt water systems had been attributed to persistent, but low concentrations of copper ion in the water at levels above .025 mg/L. Copper ion was known to have adsorbed onto or penetrated all of the tanks, calcareous gravel, concrete and fiberglass decorations. Copper originated in the systems through regular use of copper salts as an anti-parasitic treatment for fishes from 1968 until 1980. Once the copper ion concentration was brought below .025 mg/L longevity problems were still observed among certain specimens in different water systems. Water samples were analyzed by Atomic Absorbtion Spectrophotometry for specific heavy metals and the results are summarized in Table 1. High levels of nickel and copper ion were found, indicating corrosion of Monel valves.

More than 250 Monel metal valves, ranging in size from 2½ inches to 16 inches in diameter control the 1.6 million gallons of water flow from tanks, filters and reservoirs which supply the salt water systems. Monel is a trademark for a number of alloys which generally contain 67% nickel and 28% copper, as well as some or all of the following elements; carbon, manganese, iron, sulfur, silicon, aluminum, titanium and cobalt. (Dull, Metcalfe and Williams, 1962). We suspect that the nickel and copper contamination in the Aquarium's salt water systems are primarily due to the corrosion of the numerous Monel metal valves. The corrosion ranges from mild to severe (Figure 1a and 1b). Monel is known for its durability in salt water environments, (Schumacher, 1979) and was the material chosen for valves in 1969, at the beginning of the salt water system renovation work. P.V.C. or other synthetic valves were not available in the sizes required, nor could they handle the water pressures necessary.

Melitis (1985), found that one of the corroded valves had been improperly cast and/or cooled, which allowed dendrites of nickel-rich areas to form, surrounded by areas that were rich in copper (Figure 2). Corrosion occured along the dendrites. The non-homogenous metal mixture enhanced the corrodability of this valve. It is thought that other corroded valves suffer from the same problem.

Galvanic action is a form of corrosion which often occurs in salt water due to its great electrolytic potential. When two submerged dissimilar metals are in contact with each other, corrosion of one metal is expected to occur. The shafts of the Monel valves are stainless steel, but the galvanic series/steady state electrode potentials of the two metals are very close to each other at -.08 millivolts and little corrosion should be seen. Figure 1b shows a dissassembled valve with little evidence of galvanic corrosion at the steel/Monel interface. The Monel problem is not primarily associated with typical galvanic corrosion.

Several of the influent and effluent valves associated with the three diatomaceous earth filters have shown heavy corrosion. Diatom valves have been observed in this tropical salt water system that originated from the D.E.

used to charge the filters. Metals in salt waters form an oxide film over their surfaces which protects them from severe corrosion. If the oxide film is damaged or removed by physical, chemical, or biological means, corrosion will occur until the film is replaced (Schumacher, 1979). Future microscope examination of D.E. filter valves may reveal mechanical scouring of the surface caused by diatom particles regularly impinging the Monel valve surfaces.

Gerchakov and Sallman (1979), state that micro-organisms, especially bacteria can significantly accelerate the rate of corrosion on various metals. Through changes in the micro-chemical environment on the metal's surface, such as changes in oxygen concentration, pH, metabolic products, etc., a bacterial flora can be the primary cause of corrosion, or accelerate the rate of corrosion started by other sources. Mildly anerobic conditions enhance the formation of bacterial colonies associated with metal corrosion.

Monel metal shows little or no corrosion in flowing sea water. but still or stagnant waters encourages corrosion. The protective oxide film is lost from the metal's surface in stagnant, anerobic water, and may be enhanced by microbial activity (Schumacher, 1979). More than a dozen valves in our systems are normally in a closed position with stagnant water in contact with one valve face. Further investigations will reveal the state of corrosion on these valves. Figure 3a and 3b show micrographs which may be associated with potential bacterial corrosion.

Figure 4 shows an electron micrograph of a valve surface containing minute spherules of material replated onto the corroded area after initial corrosion. The material was spectroscopically determined to be almost pure copper, which suggests the area was no longer actively corroding. Perhaps such corrosion can be related to unusual water quality parameters such as lower pH values, high nitrate levels, or copper and citric acid additions to the systems in past years. As valves are removed from the salt water systems a few at a time and examined, the cause of the varying types of corrosion can be isolated. Evidence for acute corrosion periodically may be found in more valves.

The long term solution to the nickel and copper buildup in the systems is to replace the Monel valves with P.V.C. or other plastic material. The coating of non-corroded valves with teflon or epoxy material may also provide a convenient solution to the problem.

Zinc has been found in large concentrations as seen from Table 1. While higher than the average, sea water concentrations of zinc ions have been recorded from our newly made, synthetic sea water, a six fold higher concentration is seen in one of our salt water systems. It is suspected that the zinc contamination is being produced by the aluminum sacrificial bars that serve as the cathodic protection system for the structural steel mullions and bottom of our 90,000 gallon Coral Reef Exhibit. The aluminum bars have been analyzed at 95% aluminum and 5% zinc, and are actively corroding as they are intended to. Replacement of the bars with aluminum of higher purity will alleviate much of the zinc problem.

Removal of nickel, copper, and zinc ions from the water, as well as those ions which will leach from carbonate substrates, tank walls, glasses and decorations, is problematical. Other aquariums have recommended the use of

Chelex 100, a selective, ion exchange resin which chelates heavy metals and which can be regenerated after use. It is an expensive, slow flow rate material which works excellently in salt water systems for the removal of heavy metals (Bio Rad, 1976). Its use in larger volumns of water becomes cost prohibitive.

The use of activated carbon for the removal of heavy metal contaminants from sea water has rarely been viewed as an efficient filtration method. Free heavy metal ions are not easily removed by carbon from salt water. Metal ions bound with other substances may be reomved. Table 2 shows examples of the removal capacity of Barneby-Cheney, type P.C. activated carbon as used at the Aquarium. Each filter was stocked with approximately 1500 pounds of carbon and could filter a minimum of 84,000 gallons of water per day.

Algae accumulation of heavy metals is well known and some algae show the ability to release high molecular weight phenolic and polyphenolic substances into water, which are excellent complexing agents for heavy metals. (Ragan and Jensen, 1979, Ragen, et al, 1979, and Jennett et al, 1983). The presence of these complexors may be the primary reason which allows activated carbon to remove heavy metals from salt water. An algae filter is being used in our cold salt system now and produces a maximum of about 400 grams of algae, wet weight, per week. The remainder of the exhibits and reserve tanks are estimated to produce about 1500 grams per week, wet weight. A single algae analysis showed a dry weight accumulation of 92. mg/Kg of copper, 635. mg/Kg of nickel, and 275. mg/Kg of zinc. Algae filtration of heavy metals is not expensive, but requires a large amount of space and good lighting conditions to be effective.

Other means of heavy metal removal, including the use of calcium carbonate and clay minerals are being investigated at this time.

Table 1

	Total Copper mg/L	Total Nickel Mg/ L	Total Zinc mg/L
Tropical Salt System Water	.12	.28	.02
Temperate Salt System Water	.01	.12	.04
Cold Salt System Water	.01	.11	.02
Metal Free Water - made in Acid Cleaned Container	.009	.003	.017
Normal Ocean Water Average	.0013	.00355	.0069

Table 2

System Samples	Accumulation values in mg/Kg, 59 day test; 1-13-85 - 3-15-85			Accumulation values in mg/Kg, 67 day test; 3-15-85 - 5-21-85		
Tropical Salt System Carbon	Nickel 72.	Copper 525.	Zinc 45.	Nickel 38.	Copper 270.	Zinc 130.
Temperate Salt System Carbon	92.	305.	130.	35.	47.	24.
Cold Salt System Carbon	No data	No data	No data	25.	13.	18.

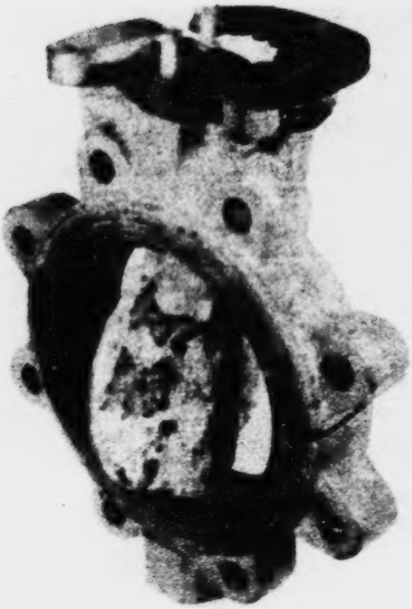


Figure 1a

Corroded 6" Monel metal valve in casing from the tropical salt system.
Photo: S. Melitis, 1985.

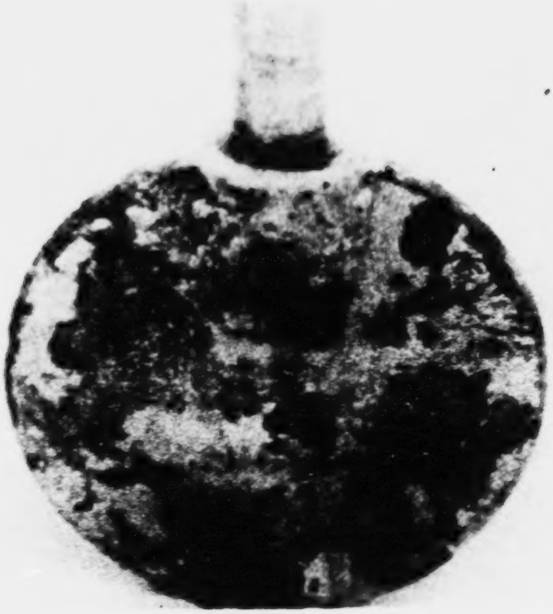


Figure 1b

Corroded 6" Monel valve and stainless steel shaft, removed from valve casing.
Photo: S. Melitis, 1985.

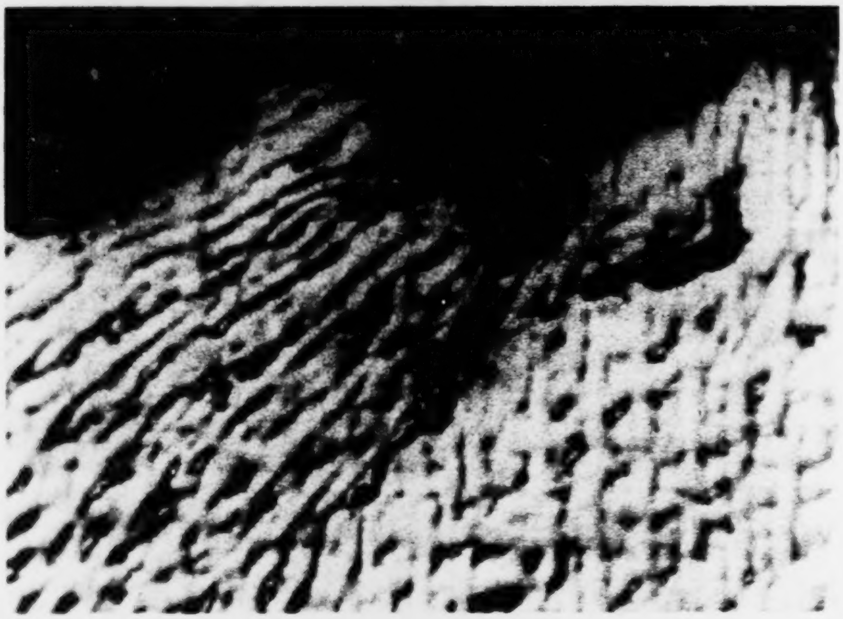


Figure 2

Optical micrographs of valve cross section showing dendritic microstructure and pitting along the dendritic arms.
Photo: taken at 50x, S. Melitis, 1985.

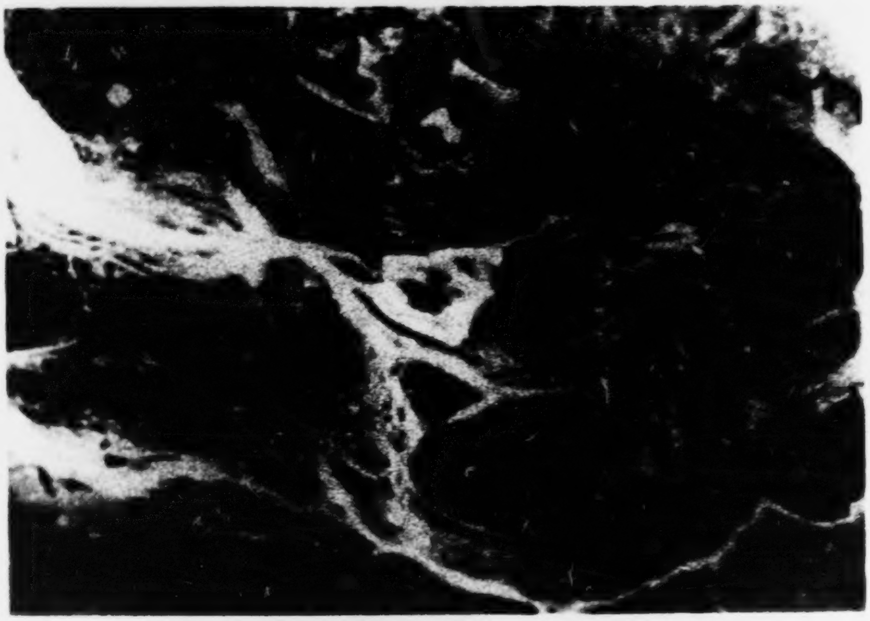


Figure 3a

SEM photomicrograph of corroded crevice of Monel valve, as a potential site of microbial corrosion. Field of photo; 248. um x 176. um.
Photo: S. Melitis, 1985.

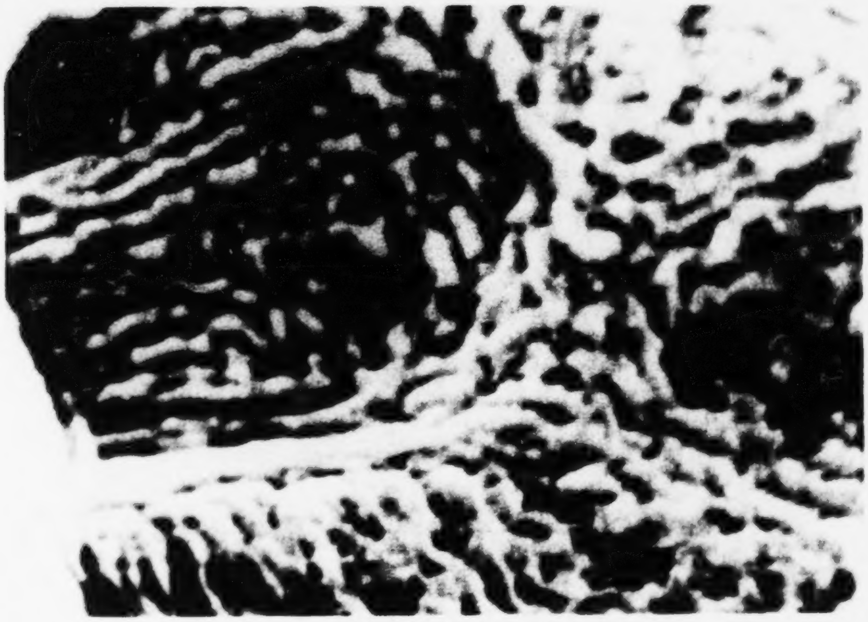


Figure 3b

SEM photo of lower left of Figure 3a. Field of photo; 41. um x 28 um.
Photo: S. Melitis, 1985.

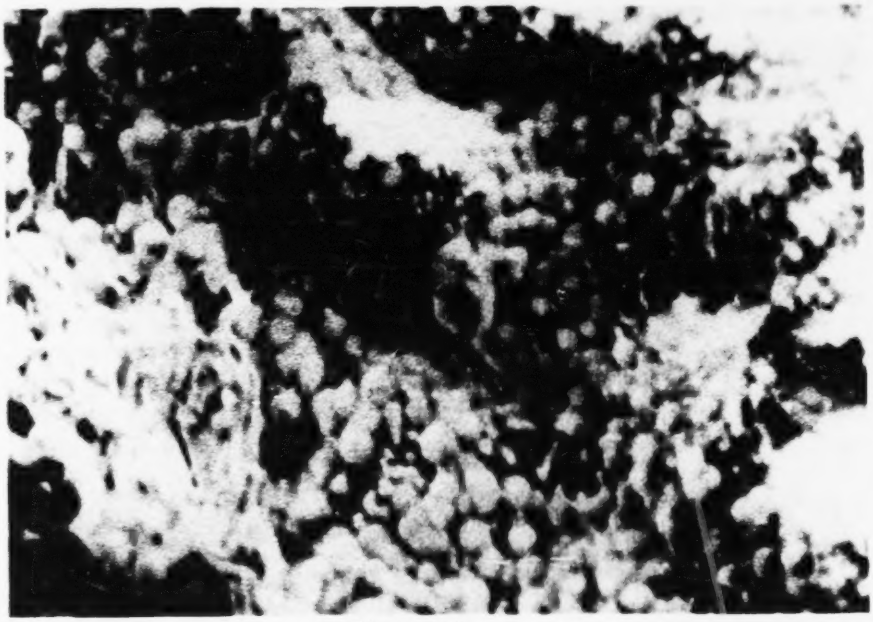


Figure 4

SEM photo of spheroids of copper replated onto corroded valve surface.
Field of photo 620. um x 440. um.
Photo: S. Melitis, 1985.

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DESIGN & CONSTRUCTION OF THE SALTWATER AQUARIUM AT THE HENRY DOORLY ZOO

By Dr. Lee G. Simmons
Director
Henry Doorly Zoo

In early 1983, we decided that a salt water aquarium would be a good addition to the Omaha zoo. This is a project that had been on my wish list for sometime just waiting for an angel.

As in all projects, the scope is determined by available funds. In this instance, it was obvious that to start from scratch and build a completely new facility would take considerable more than the dollars readily available. Additionally, we had an existing facility, a large open air picnic pavilion, with a wood shingle roof and heavy open wood trusses which had been converted early on to administrative offices and a museum. It housed a large, but aging collection of mounted heads, and a small reptile collection. This provided a perfect excuse to get rid of an exhibit that had a somewhat dubious place in a zoo full of live animals, and not having to construct walls and roof would save a great deal of money. The bad part is that while having a roof that was 14' to the eaves and 32' to the peak, it was not tremendously large in square foot area. Only 66' x 48' with a 22' x 16' wing. We decided that the best solution was to build a facility that would have a limited number of large exhibits occupying the majority of the space and that the systems would be designed for salt water. Since Omaha is nearly in the geographical center of the United States, a salt water aquarium should have a great appeal.

Based on our past experience in maintaining small (130 gallon all glass aquariums with 100 gallon buffer tanks) marine exhibits and a great deal of readily proffered and greatly appreciated advice from a number of people in the aquarium world all pointed to the need for a high off display to on display water ratio. All exhibits would be designed for maximum flexability of operation so that if in 5 or 10 years there were obvious advantages to a change in operating our managing systems, we would be able to adapt readily.

Currently there are 21 independent display systems in the aquarium. The total volume of all display systems is 70,000 gallons. 67,400 gallons of this is contained in 7 permanent concrete systems. Of the 70,000 total volume, 3,900 gallon are fresh water, the rest is in marine systems.

Our formal design criteria in utilizing this limited fixed space were:

1. First and formost, to create independent systems which would be as biologically stable as possible.
2. To create the largest possible total system.
3. To create as many large display systems having the largest possible frontal display area and volume as possible. Each system to consist of a display tank and a reserve tank capable of operating independently if necessary.

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4. To have one very large system for sharks.

5. To design marine systems having maximum flexabilities in choice of current or future management and operating systems.

6. To design for low energy requirements, low mechanical requirements and low maintenance requirements.

7. Provide adequate keeper space and work areas.

8. Leave enough room for 500,000 plus visitors per year.

To accomplish the first of these criteria, an optimal ratio of 1 to 3 for display volume to total circulating volume was established.

To accomplish the second criteria, still leave room for visitors, and guard against problems if a leak should occur, the floor of the museum was jack hammered out and dug down 6 feet. Great care had to be taken since this was approximately 2 feet below the bottom of the foundations. An accidental collapse at this point would have been impressive to say the least.

The earth in this pit was compacted, sculptured for drainage, and a double vinyl membrane laid down. On top of this waterproof membrane, a grid of perforated PVC drain tile was laid and daylighted to the downhill side of the building.

Next, approximately 18" of aggregate was placed followed by a second set of membranes. Over this, the floors and walls were poured.

No drains were provided in any of the permanent displays or contiguous reserve tanks since the bottoms of these tanks would be buried 4 feet below finished floor level.

The 4 feet of water below the display filter beds plus the 10 feet depth of the reserve tanks provides the 3 to 1 ratio total circulating volume to display volume wanted to provide good biological stability. Additionally, the contiguous reserve tank behind each display tank effectively doubles the biological filter bed area.

To accommodate large systems and adequate visitor space, the behind the tank isle space allows only skinny people.

A keeper and work space was created by pouring a concrete mezzanine 10' above the public floor space.

Construction throughout was of air entraining concrete, with a heavy schedule of epoxy coated rebar. A 4" high curb with a water stop was poured with the 24" thick floor. The 12" walls were then poured on top of this curb. A removable strip on the inside of this joint provided a caulking gap which was grouted with epoxy patching material.

The first waterproofing method tried was a cementious membrane which did not work, due to inconsistant adhesions. A combination of product and workmanship was probably at fault. While this was discovered before opening, jack hammering those areas which did have good adhesion, and applying epoxy patch and paint meant that some specimens were being put into displays literally as the ribbon was being cut.

This is where the inherent biological stability of a two tank system paid off. While the displays were being finished and glazed, the reserve tanks were online, their biological filter beds seeded and being fed first with fish emulsion and then by a reduced number of specimens waiting to go on display. When the displays and reserve tanks were coupled the total systems achieved rapid equalibrium and stability due to a large water volume to specimen ratio and rapid seeding of the display filter beds.

Glazing of all permanent displays was 3 1/2" layers of laminated tempered glass.

The glass lights were set and shimmed in the conventional manner, but sealing was with 1/2" glass cover slips bridging concrete and glass and caulked with double beads of polyurethane on each side. This, along with drainage holes out to the public space provides a dry well completely around the edge of the light and accomplishes two things. It prevents salt water from contacting the plastic inner layers between the tempered glass and if a leak should develop, a small amount of air pressure readily obtainable off of the blower system quickly identifies the location of even a small pinhole in the caulking.

The shark system was designed as a 36,000 gallon system having an hour glass shaped display to facilitate turning at the end of each glide path. It has 32' of frontal glass area divided into four lights. Illumination for all permanent displays is provided by metal halide lamps. The remaining smaller displays are either off the shelf all glass or in house built fiber glass tanks backed up with high density linear polyethylene tanks. Since the zoo built and owns the mold for these polyethylene tanks, they serve very effectively as work tanks behind the scenes in the aquarium, water tanks for hoofstock, and flower pots.

Areation and primary water circulation is achieved with 4" diameter air lifts.

A single 3 hp Rotron blower injecting 5 CFM at 48" depth into 24 4" air lifts will balance all systems and move approximately 70,000 gal/hr. Heavy fiberglass gratings supported on concrete blocks provide the base for our 8-10" deep dolemetic limestone filter beds. Multiple levels in the display were achieved by spraying fiberglass reinforced gunite between gratings placed at different heights. This also provided a very realistic looking curb at the edge of the upper level to contain the filter bed. Currently our system operates with two 3 hp Rotrons in parallel supplying air to the system through a 6" diameter PVC loop providing 1 water turnover every 35-40 minutes. The air lifts coupled with the flow rate of the cartridge polishing filters provides a maximum 20 minute turnover rate.

A 5 hp gasoline or electric Rotron blower sets outside the building in a small enclosure as backup in case of power or mechanical failure.

All display work was done in-house by zoo personnel using fiberglass

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reinforced gunite, epoxy fiberglass, polyurethane, and polypropylene building materials. Salt water is mixed in the unneeded reserve tank behind the single large fresh water exhibit.

Floors and walls of the public areas are carpeted. The public reception has been extremely good since our June 1 opening last year. Last year's total attendance jumped 38% primarily because of the aquarium.

From a more professional point of view, all systems and management practices have functioned very well when measuring in terms of water clarity, water quality (for which chemistries are run daily), and mortality. The total mortality for the first 12 months including shipping mortalities was less than 30%. Mortalities for the first quarter of our second year are running approximately 1 1/2%.

HOW NOT TO CONSTRUCT A SEA TURTLE TANK

Jeff Cook, Senior Aquarist
Toledo Zoo

Many of the methods described in this paper were in conflict with "expert" opinion. Common sense and good judgement prevailed: thus the title chosen for this paper.

In the past three years, the Toledo Zoo Aquarium has gone through a transition from "The World's Largest Freshwater Aquarium" to a less glamorous sounding "More Complete Aquarium". The addition of salt-water exhibits and more variation in specimens were two major steps.

Smoke from a November, 1982 fire killed off the small aquarium inhabitants in a display room in the aquarium. In our plans to remodel this room, it was suggested that an exhibit be constructed to house sea turtles. Other projects kept the aquarium staff busy, but in the fall of 1984, plans were drawn up and work began. (See fig.)

The sea turtle tank would be a concrete structure with three viewing panes of glass mitered together at the front corners. This 1500 gallon (5,677 l.) exhibit would be flanked on each side by a wall of smaller exhibits. Careful inspection of the floor, support pillars and beams in the basement assured us that the weight from the tank would be well supported. (The tank weighs 20,400 lb (9,261 kg.) empty.)

A half inch reinforcing rod gridwork for the walls was sunk into holes drilled into the floor. The spacing was 10" on center and securely fastened together, as is standard for reinforcement. Since the viewing side of the tank was to have the upper half in glass, with no corner posts, steel angle had to be used to support the top of the glass. This was fabricated from 5/16" x 3" x 3" (8mm x 7.62cm x 7.62cm) steel angle by our maintenance department.

This structure was then ground down to clean metal and coated with several coats of Glidden epoxy metal primer. This frame was then put into place, supported by brick pillars on either side of the tank and a steel support in front. (See fig.) This was done at this time as the back of the structure was to be imbedded in the concrete. Next, the form for the concrete had to be built. This proved more difficult than expected but, thanks to a good carpenter from our maintenance department, we accomplished this in about 40 working hours with $150. of lumber.

The wood facing the concrete to be poured was coated with a form release. As any available literature on the subject will warn: concrete is very heavy so any form work should be very strong!

The lift-tubes for the under-gravel filter were to run up the back of the tank on the outside. Two holes were cut several inches above where the floor of the tank would measure. Two holes were then cut for the return at water level (See fig.). Sections of three inch I.D. P.V.C. pipe were then inserted.

It was determined that the best way to get the four cubic yards of concrete into this part of the building would be to pump it in through a small nearby window. (This service cost more than the concrete itself.)

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The concrete was pumped through a 4" I.D. hose right into the form. The concrete was poured in layers as to "stiffen" before the next layer and to insure that it did not bust out the forms. The form was removed the following day and any voids and bubbles were filled with mortar mix. To properly cure concrete, frequent spraying with a hose is required over a several day period.

The reinforcement rods for the floor were then set up in the same 10" x 10" (25.4 x 25.4cm) gridwork. This was imbedded in the new walls 2" (5.08cm) above the existing floor. A bonding agent (Thoro-Bond) was painted onto the new wall where the floor would be poured. Since this was to be such a small amount of concrete (less than one cubic yard) bag concrete was mixed and wheeled up a ramp and dumped into the tank through the opening where the glass window would be set. This was poured to a depth of 6" (15.24cm).

After several more days of curing time, the inside of the tank was coated with Thoro-Seal, a mortar-like product most commonly used for sealing basement walls before painting. After the Thoro-Seal cured we painted the tank surfaces with four coats of Glidden epoxy paint. The steel glass structure received six coats of epoxy paint.

After curing, the under-gravel filter was installed. This consisted of a gridwork of 2" (5.08cm) I.D. P.V.C. with slits cut into the bottom. The outside lift tube plumbing was then completed. The lift tube air is controlled by 1/2" (23mm.) P.V.C. needle valves. A 1 1/2" (3.81cm.) drain was built into the bottom of the lift tube enabling the tank to be easily drained.

The dolomite and tufa tank decor were then put into the tank through the front opening where the glass would go. This was done at this time to avoid lifting this heavy material over the top of the tank.

Now, it would be very easy to build aquariums if we were not concerned with how we would see into them, thus the most difficult part: the viewing glass. The decision to use glass vs. acrylic was an easy one, based mainly on the fact that a local glass company offered to donate the glass (Toledo bills itself as "The glass capitol of the world"). Drawings and specifications were sent to the glass company and the engineers promptly deemed the project too risky without the use of support columns on each mitered corner. Our desire to keep the view open and free of interruptions that columns would create led us to research this further and, based on what has been done with aquarium glass in the past, we felt that this would be no problem. The engineers still balked. We purchased the glass and had it mitered at another firm. Cost - $2,200.00.

We set the glass using the same method as we have on our other aquarium glass. 1" x 1" x 1" (2.54cm. x 2.54cm x 6.3mm.), rubber spacers were adhered to set the glass on, these same spacers were used to space the glass out from the frame. General Electric silicone sealant was caulked into the frame and glass was fitted into place, discharging excess silicone along with any air bubbles. Excess silicone was trimmed away after curing and the tank was ready to fill. A 1/8" (.3mm) plexiglass corner was installed on each miter to prevent any sharp objects from being pushed through the thin silicone crack between the glass panes.

After the usual steps of preparing the filter bed, green sea turtles, Chelonia mydas, were added to the exhibit on 22 May 1985 and are now one of our most popular display animals. As several children have exclaimed, "Flying turtles!".

Tank Specifications:

Length	9'7"	(2.92m.)
Width	6'6"	(1.98m.)
Height	6'8"	(2.03m.)
Wall Thickness	8"	(20.32cm.)
Glass	1"	(2.54cm.)
Water Depth	5'10"	(1.77m.)
Capacity	1500 gal.	(5677.5 l.)
Cost of Materials		$3,668.00

Products Mentioned:

- Glidden Glid-Guard eopxy chromate metal primer
- Glidden Glid-Guard chemical-resistant epoxy paint

Glidden Coatings and Resins
Division of SCM Corporation
Cleveland, Ohio 44115

- Thorobond liquid bonding agent
- Thoroseal cement-base waterproof seal

Thoro System Products
7800 N.W. 38th Street
Miami, Florida 33166

- General Electric silicone SCS 1000, SCS 1200

General Electric Corporation
Silicone Products Division
Waterford, New York 12188

NATIVE FISHES OF OHIO AQUARIUM

A Cooperative Effort Between Sea World of Ohio and the Ohio Department of Natural Resources

Gary Violetta, Ken Fritz and Peter Mohan

The Native Fishes of Ohio Aquarium is a small exhibit displaying game fish, non-game fish and endangered species inhabiting the streams, rivers and lakes in Ohio. The building, approximately 70.6 square meters, has a display area of 7.3 meters x 3.7 meters or 27.0 square meters. Having a water capacity of 7600 liters, there are seven display aquariums ranging from 138 liters to 1850 liters, and six holding tanks ranging from 75 liters to 3700 liters off exhibit. Located outside behind the building are four separate quarantine tanks totaling 7400 liters. The Native Fishes of Ohio Aquarium is located in the southeast section of Sea World of Ohio behind the Seal and Otter Complex, next the the Trout Pond.

The building was erected in 1976 as a freezer unit to display a 16 foot frozen great white shark. The shark was viewed by the public on three sides, anteriorally, laterially, and caudally through insulated plate glass panels. Graphics along the west entrance wall explained shark anatomy and physiology. The Great White Shark exhibit remained for two years and in the fall of 1978 was dismantled.

The theme for the building was changed to a trout hatchery, which helped focus public attention on the trout pond. This conversion was accomplished by the addition of two 1850 liter aquariums, one 925 liter aquarium, biofilter, sand filter and pump. The Trout Hatchery was constructed so the entire display and the internal mechanical operation (filter, piping, etc.) could be observed by the public; thus giving the public an idea of the operational involvement. Three large graphics over each display and the recorded 8-track tape provided public information.

The Trout Hatchery received minimal recognition by the public. In the fall of 1980, the exhibit was redesigned to display Ohio fish. The redesigning included a major facelift to the gallery. The plate glass panels were removed and replaced with a facade where the public could view only the display, not the backarea. There was the addition of a 260 liter aquarium on the west wall and four 138 liter aquariums on the east wall.

Although the theme of the building has remained constant between 1981 and 1985, there were several changes in the mechanical operation and the physical appearance of the exhibit.

During the 1981-82 off season, the upper two 138 liter aquariums were replaced with four 37 liter aquariums. This favored displaying a greater variety of species. To provide proper control over water quality parameters in the off season, the building was winterized. This involved the installation of removable floor panels and two removable walls at the entrance and exit of the building. The major renovation was the total redesigning and rehabilitation of the filtration system. The old system was gravity fed from the biofilter to the displays. The new system incorporated a central holding tank 4.2 m x 1.2 m x .76 m or 3965 liters. Water was pumped from an undergravel filter located in half the holding tank by a 1/2 H.P. Noryl pump, through a 3 ft sand filter, to each individual display including the small displays on the east and west walls. The water overflowed the displays into a skimmer box and gravity fed back into the holding tank.

During the 1982-83 off season there were several small display changes. The 37 liter aquariums on either end were replaced with custom made fiberglass aquariums with the intent of improving the reptile and amphibian collection. An electrical timer was installed for more accurate control over the photo period.

During the 1983-84 off season, no display changes were initiated. However, due to the deterioration of the wall supports, the east display wall had to be totally replaced. Running domestic water was installed in October, 1983, improving the ease and efficiency of routine aquarium husbandry and maintenance.

The 1984-85 off season allowed a most significant change to the Native Fishes of Ohio Aquarium. The interior of the building was gutted and a new concrete floor was poured replacing the old rotted wooden floor. A concrete slab was poured behind the building providing a space for quarantine tanks. At this time, the remaining two 37 liter aquariums and two custom made reptile displays were removed and replaced with one long aquarium approximately 2.1 m x .30 m x .30 m. This display was designed and built to resemble an Ohio stream. As agreed ahead of time, the Ohio Department of Natural Resources (ODNR)-Division of Wildlife provided theme graphics and identification graphics. as well as several varieties of fish.

Because the ODNR played an important role in the reconstruction of the building, a brief history of the project and their goals should be discussed. The project, named "Do Something Wild", is funded by state taxes controlled by the Ohio Department of Natural Resources-Division of Wildlife, Non-game Program.

The history of the Non-game Program for Native Fish display began in 1983 when the Ohio legislature passed House Bill 5 authorizing the Income Tax Check-Off Program. This appeared on the Ohio State income tax form for 1983. State residents could voluntarily donate any amount of money to this program simply by checking the appropriate box and indicating the amount to be donated. The returns of the check-off tax yeilded approximately $485,000 in April 1984. Thus, the ODNR was permitted to initiate their early start up program, one of which was called "Native Fish Aquaria Project, an Educational Approach." The suspected need for educational projects was confirmed by the results of a public workshop conducted by the ODNR in October, 1984.

The goals of the Native Fishes Aquaria Project was to both entertain and inform the public about the needs of non-game aquatic resources. The idea being to increase public awareness to the problems, needs and values of non-game aquatic life and to secure public support for management of non-game aquatic life. It was thought from the beginning that these types of exhibits at high visitation areas, such as Sea World, would expose the Division of Wildlife and its programs to an audience that would not have been addressed with by other educational projects. In other words to increase the ODNR base of support in the state by demonstrating the ONDR is a wildlife resource agency, not just a hunting and fishing organization.

With all this in mind, the ODNR approached Sea World in the fall of 1984 and after a series of meetings an agreement was entered into. Basically, the agreement stated:

1) Sea World of Ohio would design, construct, and decorate a stream display on the east wall of the Native Fishes of Ohio Aquarium. The two 138 liter aquariums located below the stream display would be used to exhibit predatory fish found in Ohio streams.

2) The ODNR would provide the required animals both endangered and non-endangered as well as back-up animals for the displays.

3) The ODNR would provide a complete set of identification graphics for the new animals (totaling 20 in all) and theme graphics explaining the ODNR's involvement with Sea World and the purpose of the stream display.

It was believed both sides would benefit from the ODNR and Sea World working in tandem. The public relations opporutnities would be good for both organizations. The ODNR would achieve their goals by:

1) Sea World's aggressive P/R Department which reaches hundreds of newspapers throughout the season and

2) Exposure due to Sea World of Ohio's attendance of well over a million visitors each year.

Sea World on the other hand would promote working with the ODNR, a governmental agency, to educate the public concerning the importance of the environment through the protection of non-game aquatic life.

An additional benefit was the ability to complete projects that would not be possible to accomplish alone because of limited money, state regulations, and expertise of personnel at each institution. This latter item appeared the most important. Sea World's expertise in aquarium design and husbandry built and maintained the display while ODNR's expertise located and collected the various fishes required for the display.

Lastly, it is anticipated that this cooperation between the ODNR and Sea World will continue throughout the years.

With the exception of several theme graphics, the Native Fishes of Ohio Aquarium was ready to open on 18, May 1985.

Upon entering the building from the west, a .91 m x .61 m backlit theme graphic with a large picture of a green darter is displayed. This graphic informs the public of the cooperative effort between the ODNR and Sea World in presenting this display.

To the immediate left of the graphic along the west wall is a 260 liter aquarium displaying several of the more colorful sunfish found in Ohio waters. Species in this aquarium include the longear sunfish, _Lepomis megalotis_, pumpkinseed, _L. gibbosus_, and bluegill, _L. macrohirus_.

The next display represents a pond with above and below water viewing, mirrors on both sides to produce the barber shop effect, and several varieties of plants on a fiberglass backdrop created to resemble rock work. The fish in this display include the longnose gar, *Lepisosteus osseus*, the shortnose gar, *L. platostomus*, and the spotted gar, *L. oculatus*. The latter two species are endangered in Ohio.

Following the pond display is a 1850 liter paddlefish display. Along with the paddlefish, *Polydon spathula*, are several golden shiners, *Notemigonus crysoleucas*, and shovelnose sturgeon, *Scaphrhynchus platorynchus*. Again, the paddlefish are endangered in Ohio.

The next aquarium is a 1850 liter gamefish display. It is decorated with molded concrete, embossed, and painted to resemble rock. Small aquatic plants on the bottom and water lilies in the upper right corner complete the display. The species in this display include largemouth bass, *Micropterus salmoides*, smallmouth bass, *M. dolomieui*, black crappie, *Pomoxis nirgomaculatus*, and assorted sunfish, *Lepomis sp.*.

The last aquariums are the stream habitat displays. The actual stream habitat is a 185 liter custom built aquarium somewhat dumbbell shaped resulting in two areas of slower moving water at either end and faster moving water in between. Water is pumped into the display on the right side through a conceiled 2.5 cm PVC pipe, races through the aquarium and over flows into a skimmer box on the opposite side. The animals in this display are the rosesided dace, *Clinostomus elongatus*, red belly dace, *Phoximus erythrogaster*, black-sided dace, *Rhinichthys atratulus* and a variety of darters such as the rainbow darter, *Etheostoma caeruleum*, orange throat darter, *E. spectabile*, verigate darter, *E. variatum*, and green-sided darter, *E. blennioides*. All these fish are very colorful displaying various shades of red, orange, and green. Below the stream display are two 138 liter aquariums. One displays grass pickerel, *Esox americanus*, while the other 138 liter aquarium displays brook sticklebacks, *Culaea inconstans*. On the wall adjacent to the stream display are a series of three theme graphics explaining the stream display as well as the results of stream destruction in Ohio.

The Native Fishes of Ohio Aquarium is well received by the general public. Like all fishermen, those in Ohio talk about the type of fish they catch, people realize the large variety of colorful native fish located in the state and the public can observe several endangered animals.

Native Fishes of Ohio Aquarium has never looked better. The graphics are current and there is a large diversity of fish on display. It is Sea World's hope that this cooperation with the ODNR will continue to improve the appearance of the aquarium and help educate the public.

Videomicrographic Analysis of Gorilla Sperm

B.D. Carlton, D.L. Habash, D. Frisch, M.D. Snyder, K.G. Gould.

The characteristics of sperm in the "normal" male captive gorilla population are largely unknown. Seuanez et al (1977) described morphologic abnormalities in sperm of man and the great apes, including gorilla gorilla. They reported that the sperm of man and gorillas are the most morphologically similar of the great apes. Man and gorillas show a similar degree of sperm pleomorphism (27% in 4 human samples, 29% in 2 gorilla samples). There is a dearth of published data on the motility characteristics of gorilla sperm. This study was designed to evaluate the applicability of videomicrographic methods to sperm motility evaluation in gorillas.

Longitudinal studies of sperm motility and morphology from five adult male gorillas at the Columbus (Ohio) Zoo have been conducted from April, 1984 through August, 1985. The five gorillas represent a range of ages and reproductive histories. The oldest male, 38 years old, had sired one offspring, but had not bred for at least 9 years. He died two months after semen collection. Two gorillas, ages 16 and 18, had been actively breeding during the course of this study. The two remaining males, 11 and 20 years old, had not been observed breeding and had not sired any offspring. Semen samples were collected by electroejaculation from each of the 5 male gorillas following phencyclidine anesthesia. Immediately following semen collection into a warm (37°C) polypropylene collection dish, two drops of undiluted semen were placed on a microscope slide, coverslipped, and examined under 400 x magnification using a Zeiss inverted phase contrast microscope. All slides, coverslips, and pipettes were pre-warmed to 37°C. Each semen sample was videorecorded for a minimum of 10 10-second fields using a Dage 1000-line videocamera, Panasonic NV-8950 videorecorder, and Electrohome videomonitor. A running digital time clock was simultaneously superimposed on the video image using a Shibaden camera and Shintron synchronizer. The videotapes were later evaluated for sperm motility and velocity (direct progressive movement) using a modification of Katz and Overstreet's (1981) videomicrographic method. A semen aliquot was taken and stained with aqueous eosin Y for evaluation of sperm morphology. Four to six morphology slides were prepared and evaluated per semen sample. Sperm motility was visually estimated by two independent viewers. Agreement of the two observers was within 5%. Sperm progressive movement was measured by stopping the videotape, noting the time indicated on the videotape, and marking randomly-chosen sperm at the head/tail junction directly on the videomonitor screen. The video tape was then advanced, the same sperm were again marked on the screen and the direct distance traveled and time elapsed were recorded.

The 38-year old gorilla was found to have no motile sperm and a very low sperm count. These findings were confirmed following a testicular biopsy which showed few sperm in the seminiferous tubular lumena. Abnormal sperm morphology was observed in 49.2% of this male's sperm, including headless and amorphous- head sperm, irregular midpiece, and coiled tails. Ten to 28% of sperm in semen samples from the other male gorillas exhibited abnormal morphology including amorphous heads, pin head, enlarged head, irregular midpiece, and coiled tails. Headless motile and double-tailed, amorphous-head motile sperm also were observed from the videotape. Approximately 10% of the sperm observed on the videotapes were motile. Sperm velocity, measured as direct progressive movement (μm/sec), averaged approximately 43 μm/sec, but was highly variable, with a standard deviation of approximately 23 μm/sec.

Low sperm count, poor sperm motility, and a genital tract infection were detected in one of the males sampled. He was subsequently treated with tetracycline for a β-hemolytic streptococcus infection, but repeat sampling 4 months later showed no improvement in sperm count or motility, and the possible presence of a non-hemolytic staph infection.

Longitudinal studies of the adult male gorillas at the Columbus (Ohio) zoo indicate that there is considerable variation in sperm and semen characteristics both between individuals and for each individual over time. The percent of abnormal sperm forms observed are in agreement with those reported by Seuanez et al and are comparable to those reported in humans (Overstreet, 1981; Mann, 1981). Katz and Overstreet's videomicrographic method of sperm motility and progressive movement evaluation previously has been applied to both human semen analysis (Overstreet, et al 1981) and analysis of sperm from laboratory rodents (Carlton, 1984). We have applied the videomicrographic method to the study of rhesus monkeys and gorillas and find it is directly applicable to the study of sperm motility and progressive movement in the great apes. It provides a permanent visual record of sperm movement characteristics and allows direct comparison of specimens from different sperm donors and also of specimens from the same donors taken over time.

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THE ESTIMATION OF THE BREEDING EFFECTIVE POPULATION SIZE OF CAPTIVE POPULATIONS: THE GORILLA IN NORTH AMERICAN ZOOS

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INTRODUCTION

When considering the genetic conservation of endangered species, one theoretical concept adapted from population genetics which has increasingly appeared is that of effective population size. This concept of "effective population size" is important for long range planning of species management, but can take on an almost mystical interpretation, far beyond the actual practical insights which it provides for the zoo biologist. In this paper I hope to to clarify certain aspects of this theoretical measure which may confuse the nonexpert, and to consider some approaches to estimating and using the effective size which have often been mentioned in passing in the conservation literature, but which have received little explicit consideration. Finally, I will illustrate the methods using data gathered by the Gorilla SSP group on breeding individuals in North American zoos.

EFFECTIVE POPULATION SIZE

To determine to probable rate of loss of genetic variation from a population, the population geneticist has developed the concept of effective population size. It is important for the zoo biologist to keep in mind that this is a theoretical concept, a "fudge factor" to be used in equations. Specifically, it represents the size (in number of breeding individuals) of an "ideal" natural population of randomly mating organisms which will lose genetic variation at a rate equivalent to the rate which is occuring in some "real" population which we are monitoring. Usually, the measure of genetic variability which we are following is the "heterozygosity" in the population. This is directly related to the inbreeding level of the population, since heterozygosity is defined as the probability that two genes taken at random from the population will not be identical in type (i.e. they will not be homozygous because they were not inherited from a common ancestor). It has been known since the 1930's that heterozygosity will be lost from the population at a rate of about 1/2N per generation, where N is the value of the effective population size. Thus, we can use the N value to guide us in the management of species. For instance, the Front Royal meeting on genetic conservation suggested that species managers should aim for population sizes which will retain 90% of the heterozygosity after 200 years.

In practice, the estimation of the fudge factor is not necessarily straight forward. This is because several common biological factors act to confound our estimate. Most easily dealt with is the general fact that (especially in captive breeding populations) the number of individuals in the two sexes contributing to reproduction is not usually equal. Breeding males are most often provided with multiple potential mates, while some, or even many males may not be provided with the opportunity to reproduce. If sexual contribution is unequal, the effective population size will be affected. As an example, over the last 15 years there have been 134 potentially reproducing male gorillas and 147 potentially reproducing female gorillas. (I am defining potential reproduction for this example as reaching age eight for either sex. Behavioral studies suggest that this may not be completely appropriate, but I wish to use the data here simply to illustrate methodology. A more detailed report on gorillas, taking into account additional complications, is being prepared for future publication). The raw sex ratio among potential reporductives is 1:1.09. In this same 15 year period, the actuals number of each sex which were recorded as contributing to captive reproduction was 52 males and 72 females, a sex ration of 1:1.38. How has this change in contribution by sex altered the effective population size?

We can approach this first estimation problem using a well known relationship developed during the 1930's by Sewall Wright. To correct for sex bias we use the formula:

$$N' = \frac{4MF}{M + F}, \qquad \text{(formula 1)}$$

where M refers to the number of breeding males, F refers to the number of breeding females, and N' is the resulting effective number. Applying this formula to our data on the gorilla, we see that N' is calculated to be 120.8 (i.e. 4 x 52 x 72 / 124), comapred to a beeding number of 124 individuals. Thus, despite a fairly substantial difference in the sex ratio of breeding individuals, the resulting effective population size is 97% of the size it would be were male and female reproductives equalized.

(I want to emphasize that the numbers given here are illustrative only, although drawn from the gorilla SSP data. Since the number of individuals contributing to reproduction today is much smaller than those which have contributed over a fifteen year period, the corresponding percentage effect of unequal sex ratios will be larger. A more extensive demographic analysis than that presented here is called for. Nevertheless, the conclusion that unequal sex ratios do not contribute greatly to a depression in the effective population size will, I believe, still remain correct.)

A second factor which will act to reduce the effective size of the population (compared to the actual number of individuals) is the demographic constitution of the real population. Generations overlap, and a direct count of individuals who may not have completed reproduction will not correctly reflect the effective population size. I have not included a demographic analysis of the gorilla data for this paper (such an anaysis of reproductive rates has been done by members of the gorilla SSP, however). One factor which is apparent in the data, and which will contribute to the long term estimate of effective population size is the trend in age of reproduction of individuals over the past decade. There has been a slight trend to increasing age of reproduction for both males and females. This is illustrated by Figure 1. Two factors contribute to this pattern. First, many of the same reproductive individuals are represented in different years, as they age, while few young individuals are entering the breeding pool. This is clearly a negative factor for the gorilla population. Secondly, some of the increase results from first reproduction of previously non-reproducing older individuals, due to movement of specimens to other zoos, and to advances in knowledge of reproductive biology of great apes. This is clearly a positive factor. The longterm effects of these two patterns remain to be determined. Hopefully, the positve effects of knowledge in reproductive biology will also result in more young individuals contributing to the population.

A third factor affecting the effective population size has been often mentioned, but rarely determined. This is the effect of variation in offspring number among individuals of the same sex. In human population genetics this is sometimes referred to as the "headman effect" and is known to cause significant reductions in the effective population size. The theoretical methods available to calculate this change involve approximations, and have been given in Cavlli-Sforza and Bodmer (1971). The correction factor for use in determining effective population size is given by:

$$\frac{1}{1 + \frac{V(k)}{k^2} - \frac{1}{k}}, \qquad \text{(formula 2)}$$

where k is the average number of offspring per reproductive individual (non-reproductive individuals are excluded), and V(k) is the variance in offspring number.

We can use the data from the gorilla SSP to calculate the mean and variance of offspring number for reproductive individuals over the last fifteen years. (Note that, again, this results in the data being used as an illustration, since we would like to calculate the current effective population size and not all these individuals are currently reproductives). The calculated average and variance of offspring production are as follows. For males: average = 2.86 offspring/reproductive male; variance = 5.65. For females: average = 2.19 offspring/reproductive female; variance = 2.19. Note that the variance and mean for females are essentially equal, while the variance is much greater than the mean for males. Theoretical assumptions in population genetics usually begin with the "ideal" population, which would have a mean and variance equal, as for female gorillas in captivity. As the variance increases, the effective population size decreases; conversely, with decreasing variance in offspring number, the effective size will increase. In fact, if we can reduce the variance to zero, we can make the effective size double the size of the actual population. The effect of the increased variance in males will be to decrease to size of the effective population size. To illustrate the type of variation in offsping production which we are observing, the distribution of offsping number among different reproducing male gorillas is shown in Figure 2. In contrast, the distribution among females, which is shown in Figure 3, is similar but causes little alteration in the effective population size of females.

To return to the gorilla data, we can determine that the correction factors calculated from formula (2) for males and females will be 0.747 and 0.999, respectively. We can then apply these correction factors to the number of breeding males and females in the population and then use formula (1) to obtain a final corrected effective population size. This is determined to be approximately 100.8, a 17% reduction in effective population size. In my opinion, this is a relatively minor reduction in the population size.

To illustrate this point, Table 1 shows the rate of loss of heterozygosity (compared to the present level) for populations which have an effective population size equal to the actual size of the present population, the size utilizing Formula (1) and the size utilizing Formula (2), when the SSP data for gorillas reproducing over the last 15 years is analyzed. The time span is taken to be twenty generations, assuming a ten year generation period as a very preliminary starting point. This would provide us with an estimate of the total loss over 200 years, the time period suggested by the Front Royal Conference as being the target management period. It can be seen that even over 20 generations there will be only a 2% difference in the amount of genetic variability which is expected to be retained in the population.

DISCUSSION

I feel that the small size of the correction to the effective population size causes one to question the utility of excluding (or reducing) the contribution of males who already are "well represented" in the offspring gene pool. It is often argued that we must act vigorously to equalize offspring contribution to maximize effective population size. Since the males most likely to be excluded are known successful breeders, their usefullness in contributing to the population as breeders would appear to override the small negative effect of increased loss of genetic variability (i.e. increased rate of population inbreeding). Only if the effective population size were very small, and male reproductive contributions even more variable than seen for gorillas, would the increased difficulties of equalizing male contributions seem to be worthwhile. For populations such as gorillas or some of the large cats in which founder population size is fairly large, it would appear to me to be more profitable to work for maintaining the population size, rather than making an extraordinary effort to equalize offspring number by reducing the contribution of any "supermales." Table 1 indicates that even with the unmanaged variation in offspring numbers, the difference in rate of loss of genetic heterozygosity will be trivial (especially compared to other potential factors which will be operating).

The methods which are presented here form a first step in the estimation of effective population size. Additional calculations may be necessary to take into account the demographic structure of the population. For most purposes, however, the additional complications of the demographic analyses may not result in substantially greater insight into the factors reducing genetic variability, and simple approximations of the methods given here should be useful for most management applications.

ACKNOWLEDGEMENTS

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TABLE 1

PERCENT OF INITIAL HETEROZYGOSITY RETAINED IN THE POPULATION
(rate of loss calculated as 1/2N per generation)

GENERATION	RAW DATA (N=124)	SIMPLE CORRECTION (N=120.8)	CORRECTION FOR FERTILITY VARIATION (N=100.8)
5	98.0%	97.95%	97.54%
10	96.04%	95.94%	95.15%
15	94.12%	93.97%	92.81%
20	92.23%	92.04%	90.53%

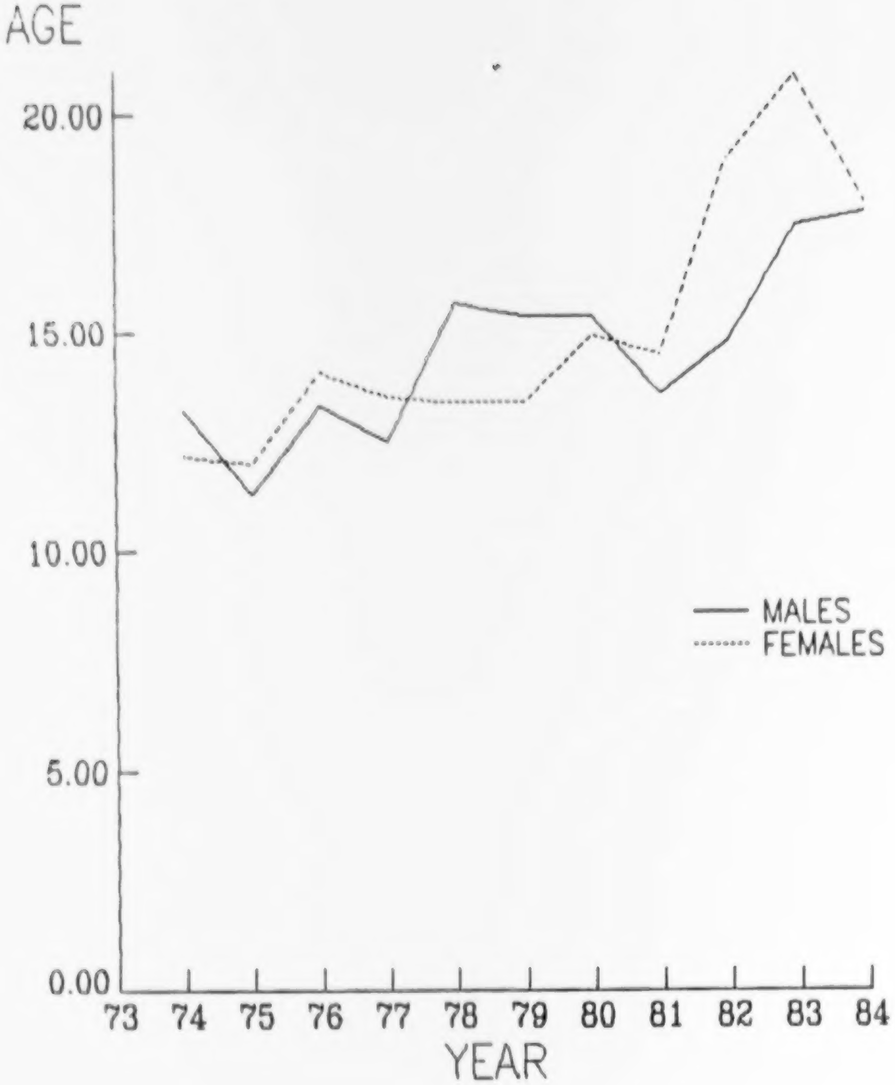


FIGURE 1

AVERAGE AGE OF REPRODUCTION
PARENTS OF GORILLA OFFSPRING BORN IN EACH YEAR

FIGURE 2

VARIATION IN PROGENY PRODUCTION - MALES

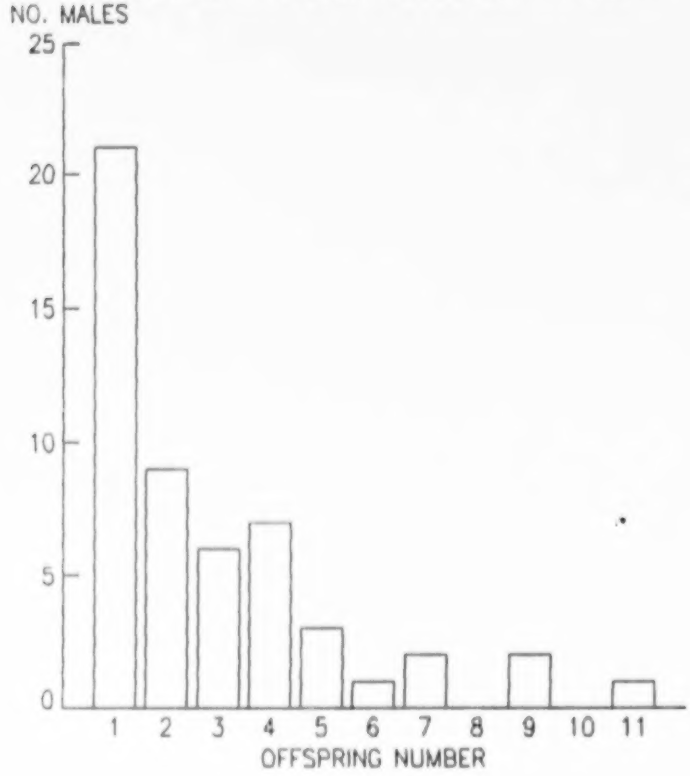
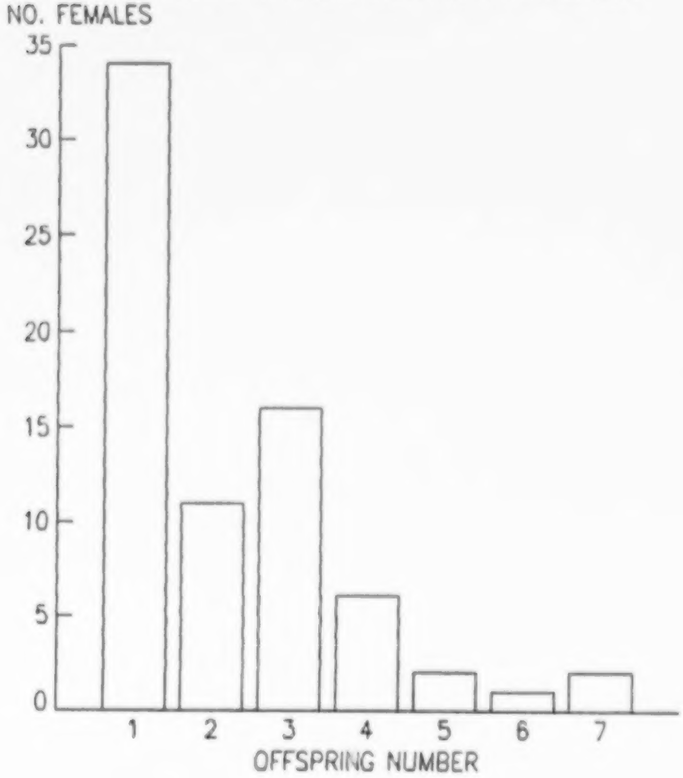


FIGURE 3

VARIATION IN PROGENY PRODUCTION- FEMALES



The Introduction of Peer-raised Gorillas to a Mother/Infant Pair

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Gorillas have been raised in captivity sucessfully for less than fifty years, and bred in captivity for only about thirty years. As a species, gorillas are intrinsically interesting to humans, and many aspects of their behavior and physiology have been well-researched during this time. One aspect of captive gorilla behavior which has received little attention is the initiation of individuals into social groups. Captive management necessitates frequent re-formation of gorilla groups. For example, adult males are introduced to new females for breeding purposes. Human-reared young are placed with others for peer-raising, or may be introduced into social groups. Because of the small number of gorillas in captivity, and the wide variety of circumstances under which gorilla introductions take place, the procedures for introducing gorillas have not been systematically evaluated and reported. The introduction of three peer-raised young gorillas to a mother/infant pair at the Stone Zoo in Stoneham, MA. is presented here to evaluate the efficacy of the introduction procedure used in this particular situation, and to make some general recommendations for gorilla introductions from the knowledge acquired during this introduction.

Subjects.

The introduction involved 3.2 lowland gorillas (*Gorilla gorilla gorilla*). Gigi, an adult female born at the Cincinnati Zoo and human-reared, was twelve years old at the commencement of the introduction. Kubandu, Gigi's second offspring was 18 months old, and had been reared by and exhibited with his mother since his birth. Quito, Gigi's first offspring, had been rejected by her at birth, and consequently was human-reared. At 12 months old, he was put into a group with two other young human-reared gorillas for peer-raising at Stone Zoo. Kiki, a female from the Philadelphia Zoo, and Gus, a male from the Bronx Zoo, were brought to Stone Zoo to be peer-raised with Quito when they were both 10 months old. The peer group remained together and had no physical contact with other Stone Zoo gorillas prior to the introduction, although at various times the young gorillas were able to view gorillas in other exhibits. Quito, Kiki, and Gus were respectively 3 years 2 months, 3 years, and 3 years old at the onset of the introduction.

Procedure.

The introduction involved several phases. Phasing proceeded gradually, and progression from one step to the next was based on the gorillas' behavior. The pre-introduction phase began in May of 1984, with the movement of the three peer-raised gorillas to the exhibit adjacent to the one which housed the mother/infant pair. These two exhibits share a common central door which can be opened to allow access to the opposite side. The door is constructed of metal bars and is designed with a ratchet so that it can be opened into a variety of intermediate widths. A one inch wire mesh was secured to the center door as a precaution against injuries resulting from grabbing or biting through the bars. Beginning on 22 May 1984, the three juvenile gorillas were given daily access to Gigi's exhibit while Gigi and Kubandu were locked in their

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den. This exploration time was provided for approximately one hour each morning. On 5 July 1984, Gigi and Kubandu were similarly allowed to explore the juveniles' exhibit while the young gorillas were secured in their den. Visitations were alternated on a daily basis. On 14 August 1984, the wire mesh was removed from the center door, permitting more tactile interaction among the animals. The introduction phase began one week later when, on 21 August 1984, the center door was opened for the first time. The door was fixed in a partially open position through which the young gorillas could pass into either exhibit , but which restricted the adult Gigi to her exhibit. The center door was opened for approximately one and one-half hours each weekday morning. On 1 October 1984, the center door was opened all the way for the first time, allowing Gigi access to either exhibit. This procedure continued for several weeks until it was determined that a schedule of four morning per week with the door partially opened and one morning with the door fully opened was more conducive to social interactions. For the first two months of the introduction, fire hoses were available for emergency separations. The hoses were never needed. Zoo staff continuously monitored all pre-introduction and introduction sessions. In May 1985, the third and current phase began with the gorillas together all day except for feeding times. The center door is maintained in a partially opened position except for one morning per week when it is fully opened. Staff monitoring is periodic rather than continuous. The animals are still separated into their own exhibits for the night.

Results.

Pre-introduction (8 May 1984 - 20 August 1984). When first placed into the exhibit adjacent to the mother/infant pair, the juvenile gorillas exhibited a great deal of interest but were quite cautious in approaching the center door. The adult female Gigi showed equal interest and approached without hesitation. The infant Kubandu did not approach the door directly, and did so only as a passenger mounted ventral-dorsally upon his mother. Within two weeks all animals were approaching and spending time at the center door. The young male Gus would pass tidbits of food to Gigi through the wire mesh. All animals were sniffing and touching through the mesh. The behavioral indication that the gorillas were now showing regular, frequent - though limited - social interaction at the center door marked the point where visitations to the opposite exhibit began. The one hour visitations were characterized by play and exploration with some contact between the gorillas in the exhibit and the gorillas in the den. By mid-August, all of the gorillas were thoroughly familiar with all areas of both exhibits, and continued to frequently socialize at the center door. On 14 August 1984, the wire was removed from the door. Greater contact through the bars of the door was now possible. Hand slapping and tagging became regular games, with occasional passing of food or hay. Grabbing occurred frequently. To avoid injury, the wire mesh was put back on for the nights.

Introduction (21 August 1984 - 28 May 1985). The behavioral criteria for the opening of the center door were that all animals were familiar with both exhibits, and all were interacting throuugh the bars at the center door. These criteria were met within one week of the removal of the mesh. The center door was opened for the first time on 21 August 1984, and is referred to as Day 1 of the introduction. The door was positioned to an intermediate width which allowed the young gorillas access to both sides, but restricted Gigi to her exhibit. On Day 1, The juveniles immediately entered Gigi's exhibit. Gigi initially retreated in apparent surprise, then chased the intruders back to their exhibit. The remainder of the first session included slapping bouts between Gigi and the young males, several chases initiated by Gigi and accompanied by much screaming, juveniles playing in Gigi's exhibit close to the center door, and some interaction between Gus and Gigi at the door. The young female Kiki spent less time in Gigi's exhibit than did the males. Day 2 began with the juveniles entering Gigi's exhibit with more caution. Gus, the young male who had periodically fed Gigi through the mesh, approached the

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infant Kubandu who was not at that moment being held by Gigi. Gus engaged Kubandu in a ventral-ventral embrace. Gigi approached the pair from behind Gus and embraced both of the young animals in an apparent attempt to retrieve her infant. Gus began to scream which seemed to cause Kubandu to cling more strongly to Gus as Gigi attempted to extricate Kubandu from Gus' arms. After thirty seconds of screaming, struggling, and chasing, Gus retreated to his exhibit and Gigi retrieved Kubandu. For two weeks, Gigi was extremely protective of Kubandu. On Day 8, Kubandu did manage to slip from Gigi's hold and enter the juveniles' exhibit on his own for the first time. His sojourn was brief, a matter of seconds, and he retreated to Gigi's beckoning arms.

By the third week all of the juveniles were spending at least some time in Gigi's exhibit. The young gorillas would play while Gigi, holding Kubandu, would observe. The juveniles were very wary and retreated at the least sign of movement on Gigi's part. Touching was done across the safety of the center door, usually at arm's length. Gus would occasionally reach out and touch Gigi from behind as she was walking away from the door. Slide chases initiated by Gigi, which never failed to cause the juveniles to retreat, seemed to be her major means of interacting with the young gorillas when they were in her exhibit. By this time the center door was clearly used as a safety zone by the juveniles. Kiki was the most reluctant of the three to enter Gigi's exhibit. She would station herself on her side of the door, observe Gigi's location, venture about three feet into the exhibit, and hastily retreat. By the fourth week, the first touching initiated by Kubandu in the exhibit and not at the center door occurred. Quito, using his arm as a fishing line, hung over an elevated bench while Kubandu jumped and swung from the dangling limb. It was also the week of the first major altercation. Quito, the dominant member of the peer group, would often threaten Gigi by chest beating and throwing hay. He would ignore Gigi's threats. Facial gestures and vocalizations by Gigi were sufficient to send Kiki and Gus into retreat. Chases were Gigi's only recourse with Quito. During the fourth week, Gigi cornered Quito in her exhibit, and grabbed, slapped, and pulled at him as he attempted to escape. Quito was panting hard and physically exhausted by the incident but he was not injured. In fact no injuries beyond a few minor scrapes occurred throughout the entire introduction. It is interesting to note that Quito's peers came to his aid. It was the first of many occasions when the peer group would band together in defense and offense against Gigi.

In the fifth week on Day 30, the center door was opened completely for the first time. Gigi charged into the juveniles' exhibit, and the young gorillas retreated into her exhibit. In essence an exhibit reversal took place. Little interaction occurred, even at the center door. After a few weeks of opening the door completely every session, a decision was made to open the door fully only once per week and open the door in the partial position on the other four days. It appears that the escape option presented by the partially opened door facilitated social interaction, while the completely opened door merely led to exhibit reversals.

Integration (29 May 1985 to present). The introduction proceeded gradually, characterized by weeks of no major behavioral change, then seemingly sudden significant progress. For example, eight months after the Day 2 struggle between Gus and Gigi over Kubandu, Gus finally allowed Gigi to touch him away from the security of the center door. It is impossible to relate every significant or interesting incident here as there are so many. On 29 May 1985, the gorillas began a more normal schedule of integration. They are together daily except for feedings, but are still separated at night. Their current behavior is a far cry from the caution and distance which characterized the first phase of the introduction. Kubandu who would only touch and be touched at arm's length now regularly wrestles and tumbles with all of the juveniles. With his increasing independence from Gigi, Kubandu spends extended periods daily at play with the juveniles in the juveniles' exhibit, ignoring Gigi's calls and gestures for retrieval. Gigi is extremely tolerant of the juveniles and rarely chases them from her exhibit.

Chases now are a form of play not threat, and the juveniles do not leave the exhibit in response to Gigi's chases. Gigi and Gus have frequent contact. Kiki is still somewhat wary of Gigi but engages in play and maternal-type behavior with Kubandu whenever she can.

Conclusions.

The gorilla introduction at Stone Zoo was carried out to merge 3.2 captive gorillas, four of whom were human-reared, into a socially interacting group. The introduction procedure was designed to minimize stress to the animals during the introduction. Factors important to this goal were letting the animals' behavior guide the procedure, i.e. letting them set their own pace; and giving the animals options in the case of the ratchet-controlled door rather than forcing them into contact. In evaluating the success of the procedure reported here, certain points are clear. The gorillas are socially interacting. No serious injuries occurred. No human intervention or assistance was required. The gradual nature of this procedure may require more time but it did not overly burden zoo staff. It was done right in the gorillas exhibits and provided an interesting and educational experience for zoo visitors. Perhaps the most stringent test will occur when the young gorillas adjust to other new gorillas yet in their future.

One other factor merits attention. The positive effects of peer-raising these human-reared juveniles were demonstrated throughout the introduction. The juveniles came to each others aid during fights, banded together in defense of their exhibit, and sought comfort from each other when frightened. The fact that the three were introduced simultaneously to the adult may have contributed to minimizing stress and facilitating socialization.

The successful introduction of three peer-raised juvenile gorillas to a mother/infant pair at Stone Zoo offers some suggestions for other zoos contemplating introductions. Allowing the gorillas to proceed at their own pace by utilizing behavioral criteria as guidelines and offering options rather than forcing interaction can contribute to successful social integration of unfamiliar animals.

Special thanks to the Stone Zoo gorilla team, and to Lana and Don Reed and the Videorangers.

BEHAVIORAL DIFFERENCES IN MOTHER-REARED AND HAND-REARED INFANT LOWLAND GORILLAS (Gorilla gorilla gorilla)

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ABSTRACT: Four hand-reared infant gorillas were compared with three mother-reared infant gorillas. Differences in both the quantity and quality of social behaviors were found. This reinforces the importance of allowing mother-rearing in captivity whenever possible, as well as the need for early reintroduction of hand-reared gorillas into gorilla groups.

INTRODUCTION

Hand-rearing of infant lowland gorillas (Gorilla gorilla gorilla) is common in captivity. As of 1981 two thirds of the 121 viable births in the U.S. and Canada resulted in removal of infants from mothers (Satterfield and Kiser, unpublished survey). Failure of hand-reared animals to reproduce, or failure to demonstrate maternal competency when they do reproduce, is also common (Clark, 1981; Thomas, 1981). Reasons for maternal incompetency seem to be complex. Removal of a mother from her social group can cause abuse or neglect (Nadler 1974; Frueh, 1968). Some premiparous mother-reared gorillas with no past opportunity to observe mothering behavior have cared for their infants (Beck, 1984 and Nadler, 1974). Beck asserts (1983 and 1984) that lack of novel or social stimuli in general during early developmental stages is the basic cause of a female gorilla's inability to cope with the birth and care of an infant.

It has been well documented in the research of Harlow and others (eg. Harlow, Dodsworth, and Harlow 1965; Harlow and Harlow, 1962; Rowland 1964; Senko, 1966; Harlow and Suomi, 1971; Arling and Harlow, 1976; Mason, 1979) that adult behavioral inadequecies in monkeys can be related to deficits in early development. Social competency in monkeys increases on a continuum from isolate-reared to peer-reared to nuclear family-reared (Suomi, 1974). It is reasonable to assume that similar developmental processes may be present in the gorilla.

Reports on gorilla development have been of a small sample size (usually one to three individuals) (eg. Hughes and Redshaw, 1973 and 1974; Kirschofer, 1967; Bowen, 1980; Carpenter, 1937). Studies have frequently emphasized physical development (eg. Thompson and Kawata, 1984 and Smith, 1978). Behavioral development was reported on by Hoff, Nadler and Maple (1981 a and b) and by Redshaw and Locke (1976). Fossey's notable study on feral mountain gorillas (Gorilla gorilla berengei) in 1979 included 32 infants. Schaller reported that he sampled "numerous" infants in his 1963 book. Unfortunately the variety of methodologies used, the emphasis of each study, and environmental and observer variations, make comparison from study to study difficult. There have been no reports of comparisons between hand-reared and mother-reared infant gorilla development within one systematic study.

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METHODS

One/zero sampling (see Altmann, 1974) was used during 15 second intervals. One-hour sessions were done between 1300 and 1600 hours. Three observers collected data with an interobserver reliability not less than 94%. Subjects were three hand-reared infants at San Francisco Zoo, one hand-reared at Milwaukee County Zoo, one mother-reared at Lincoln Park Zoo, and two mother-reared at Chicago Zoological Park (Brookfield Zoo). Infants were between the ages of 20 and 42 months inclusively during the study. All hand-reared infants were caged with peers and were partially introduced to older animals at the time of the study. See Appendix A for details. Behaviors are described in Appendix B. The study was done from March 1983 to August 1984. A total of 92 hours was collected (average per animal was 13 hours).

The number of intervals scored for each behavior was converted into percent of intervals for each animal. Mean percentage scores for the mother-reared and hand-reared groups were calculated. These are presented in Tables I and II. Even though there were individual variations in scores, differences in enclosures, various group compositions and group sizes, the mean scores for the mother-reared and hand-reared groups on the whole showed distinctly different patterns for several behavioral categories. Statistical significance of differences between the two groups were calculated by a test for significance of a difference between two proportions (Bruning and Kintz, 1968). The critical *z* scores were 1.96 and -1.96 at the .05 level using a two-tailed test.

RESULTS

There were no apparent behavioral sex differences. The two males, one hand-reared and one mother-reared were more like their respective groups than they were like each other. The same was true for the females.

Nonsocial behaviors showed no major differences between the two groups, except in object contact The hand-reared mean score was 61%, while mother-reared was only 27.3%. This can be accounted for by the tendency of the mother-reared groups to have fewer loose objects to manipulate and the tendency of the adults in those groups to claim any interesting objects that were available. Hand-reared infants showed somewhat more locomotion than mother-reared (38% M-R, 42.75% H-R, *z*=2.74). Resting was not significantly different in the two groups. Hand-reared animals played without partners (Solitary Play) only .55% more than mother-reared animals.

Sexual behavior (Genital Inspect and Copulatory Position/Motion) was minimal in both groups at 1.12% M-R and 1.1% H-R.

Both groups initiated more approaches (10% M-R, 17% H-R) than they received (5.3% M-R, 8.7% H-R), however, the hand-reared group both initiated and received significantly more approaches (15.3% M-R, 25.7% H-R, *z*=7.27)in total.

Proximity (within arm's reach of another) to other animals was significantly different in total (71% M-R, 46% H-R, *z*=14.32). Proximity to other infants was higher in the hand-reared animals (11% M-R, 42% H-R, *z*= 9.79). Proximity of mother-reared infants to their mothers was 42.7%. This

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figure is remarkably close to the same proportion of intervals that hand-reared infants spend within arm's reach of their peer group members. Percent of intervals in proximity to older animals ("others") was significantly higher for mother-reared animals (17.3% M-R, 4.6% H-R, *z*=7.73). This is probably accounted for by the fact that the hand-reared animals are not yet fully integrated into their social groups (Meder, 1985). They have access to cages via squeeze doors, where the larger animals cannot go. Mother-reared animals have ample opportunity to avoid larger animals in their huge exhibits with many visual barriers, but they do so less than hand-reared animals. Fossey (1979) reported wild infants to be within arm's reach of mother 35% of the time at age 36 months. In the present study, infants averaged 42.7% of intervals within their mothers' reach.

The percent of intervals for in which infants were rated as "near" (out of reach but within 15 feet) showed a total (averaged from "infant" and "others") of 100% near all other animals. Mother-reared totaled 77% of intervals near all other animals. Near other infants was much higher for hand-reared gorillas (19.7% M-R, 64% H-R, *z*=25.34). Near to older animals (other than mother) showed only a slightly significant difference (31.7% M-R, 36% H-R, *z*=2.57). Infants were near their mothers 25.76% of intervals. Note that the mother-reared seem to be in proximity and near for a similar proportion of intervals (71% and 77%), while the hand-reared animals scored twice as many intervals near as they did proximate on the whole. At age 36 months, wild infants averaged 20% of time observed Near their mothers in Fossey's study. We found the average percent of intervals of mother-reared captives within 15 feet of mothers to be 25%.

The category of social play contained statistically significant differences in each aspect. Total social play was higher for hand-reared (13.4% M-R, 16.155% H-R, *z*=2.49). Quality of social play, however, is interestingly different from mother-reared to hand-reared infants. Mother-reared play consisted of more initiate and receive, short-term play, while hand-reared play was mainly long-term, continuous "mutual play" (play that took place over several intervals without being terminated or re-initiated). The mean scores were .002% M-R, 11.05% H-R, *z*=13.22.

In the two groups, use of display behavior was different in both quantity and quality. The percent of difference was significant (2.17% M-R, 7.6% H-R, *z*=7.09). The most important difference was a behavioral difference. Mother-reared gorillas used display components in both play and aggression, whereas the hand-reared gorillas were seen only to use display during play or excitement. There is a possibility that this low occurrance behavior was misrepresented due to the small number of observation hours (mean of 13). A study with more hours may uncover aggressive display behaviors in the hand-reared.

The most striking difference in behavior was in the category of "touch". All differences were statistically significant. Total touch for mother-reared was 86.93% and the total for hand-reared was 24.1% (*z*=43.69). Fossey reported an average of 30% of time observed in contact with mother by age 36 months. The captive mother-reared mean percent of intervals in contact with mother in the present study was 22%. Mother-reared infants initiated more touching (18.7% M-R, 3.7% H-R, *z*=14.78). Mutual contact (unbroken contact that is not re-initiated, but continued over more than one interval) was higher in mother-reared animals (20.2% M-R, 16.05% H-R, $\underline{z}$=3.04). "Miscellaneous touch" (ventro-ventral, ventro-dorsal, nipple contact, lifting/carrying of or by another) was experienced only by the mother-reared infants (20.93% M-R).

DISCUSSION

Smith (1980) states that gorillas "apparently...do not have an innate identification with their own species...since as adults, hand-reared gorillas still seem to prefer human contact." The hand-reared infants in the present study showed definite behavioral differences from mother-reared gorillas, even though they were placed in peer groups at some point in infancy. It is possible that peer-rearing may alleviate species self-identification problems, but the hand-reared infants in this study are still undergoing different social contact and play experiences than mother-reared infants. The lack of variety of gorilla/gorilla contact experiences may be important. Physical contact was the method by which "therapist" infant rhesus were able to "normalize" isolate-reared infants' social behavior (Suomi, Harlow, and McKinney, 1972). Whether or not there are any permanent differences in hand-reared infants we will not know until they reach maturity. Inappropriate behaviors can disappear during development and reappear as self-aggression and social threats in maturity (Suomi, 1971). Note that hand-reared animals in this study experienced rough contact as their main form of touching. Their behavior seems more appropriate to older animals in the juvenile (4 to 6 years) stage (Fossey 1979), since they spend much time in rough and tumble play. Fossey found that in natural gorilla family groups, infants shared the proximity of older animals without becoming involved themselves; "...even when alone, however, the infant gained knowledge of socially acceptable behavior by his awareness of the actions of others within the group...". Our hand-reared, peer-grouped infants may be lacking in "gorilla etiquette" which may further exclude them from gaining normal behavior once they enter a social group with adults. Overall the picture of a hand-reared two-year old gorilla, partially integrated into a gorilla group is one of an animal that approaches more often, displays more often, spaces itself differently and plays more roughly and longer (as its main form of physical contact) than mother-reared animals of its own species.

CONCLUSIONS

The exact mechanisms of gorilla development have not yet been elucidated. Specific infant deficiencies have not been shown to be causally related to specific deficiencies in adulthood. By age two, however, there are behavioral differences in mother-reared and hand-reared infants. The differences, especially in contact, may influence adult social life, including reproductive and maternal adequecy. The evidence indicates that for proper social development the best policy in captive rearing would be allowing mother-rearing whenever possible. Peer-rearing and hand-rearing should be regarded as inadequate for complete social development in gorillas. Infants should be returned to a group with adult gorillas at the earliest possible age if hand-rearing is necessary.

ACKNOWLEDGEMENTS

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APPENDIX A

SUBJECT	SEX	BIRTH/PLACE	REARING	STUDY SITUATION	ENCLOSURE	STUDY AGE
Bawang	F	13 July 80 Cincinnati Zoo	Hand-reared with siamang to 17 mo.s	San Francisco Zoo. Peer group of 3. Access to group of 7: 1 adult male, 2 adult females, 2 subadult males.	Several large indoor cages approx. 10'X10'X8'	36 mo.s
OJ	M	31 July 81 Columbus Zoo	Hand-reared with Zura.	Above.	Above.	30 mo.s
Zura	F	13 Sept 81 Columbus Zoo	Hand-reared with OJ.	Above.	Above.	28 mo.s
Beck	M	15 Oct 81 Chicago Zoological Park (Brookfield)	Mother-reared in a group of 5: 1 adult male, 2 adult females, 1 other infant. Chicago Zoological Park.		Large indoor stylized naturalistic exhibit approx. 100'X60'	25 mo.s
Aquilina	F	15 Dec 81 Chicago Zoological Park (Brookfield)	Above.		Above.	23 mo.s
Matadi	F	9 Feb 82 Lincoln Park Zoo	Mother-reared in a group of 13: 2 adult males, 4 adult females, 3 juveniles, 1 infant*		Large 2 1/2 story habitat.	27 mo.s
Mandara	F	5 April 82 Lincoln Park Zoo	Hand-reared at Milwaukee County Zoo. At 19 mo.s joined by 4 mo. old male.	Milwaukee County Zoo. With same male, access to 4 yr. old male. through squeeze	Two/three indoor glass front, tile cages appros. 8'X12'X8'	20 mo.s

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*This group's members were occasionally changed as management necessitated.

APPENDIX B

BEHAVIORS

APPROACH: Focal animal moves toward another, or another animal moves toward focal, to within proximity (arm's reach of the larger animal.

TOUCH: Physical contact, other than below.

MISCELLANEOUS TOUCH: Lift/hold another animal (weight supported by another), carrying or being carried, ventro-ventral contact, dorso-ventral contact, nipple contact.

PROXIMATE: Within arm's reach of another (arm length of larger animal).

NEAR: Out of arm's reach of another, but within 15 feet.

OBJECT CONTACT: Contact with toys or any loose object.

SOLITARY PLAY: Active self motion such as swinging, rolling, sliding, without a partner.

SOCIAL PLAY: Physical, active play with a partner including "rough and tumble" play, tickling, wrestling, chasing.

LOCOMOTION: Continuous horizontal or vertical movement of at least one body length during a trial.

REST: In an inactive state for five seconds or more.

DISPLAY: One or more of the following: chest beating, bipedal run, throwing, leg kicking, slapping/tearing, whipping, thumping/slamming, strutting, threat face ("tense lips"), or quarter turns of head.

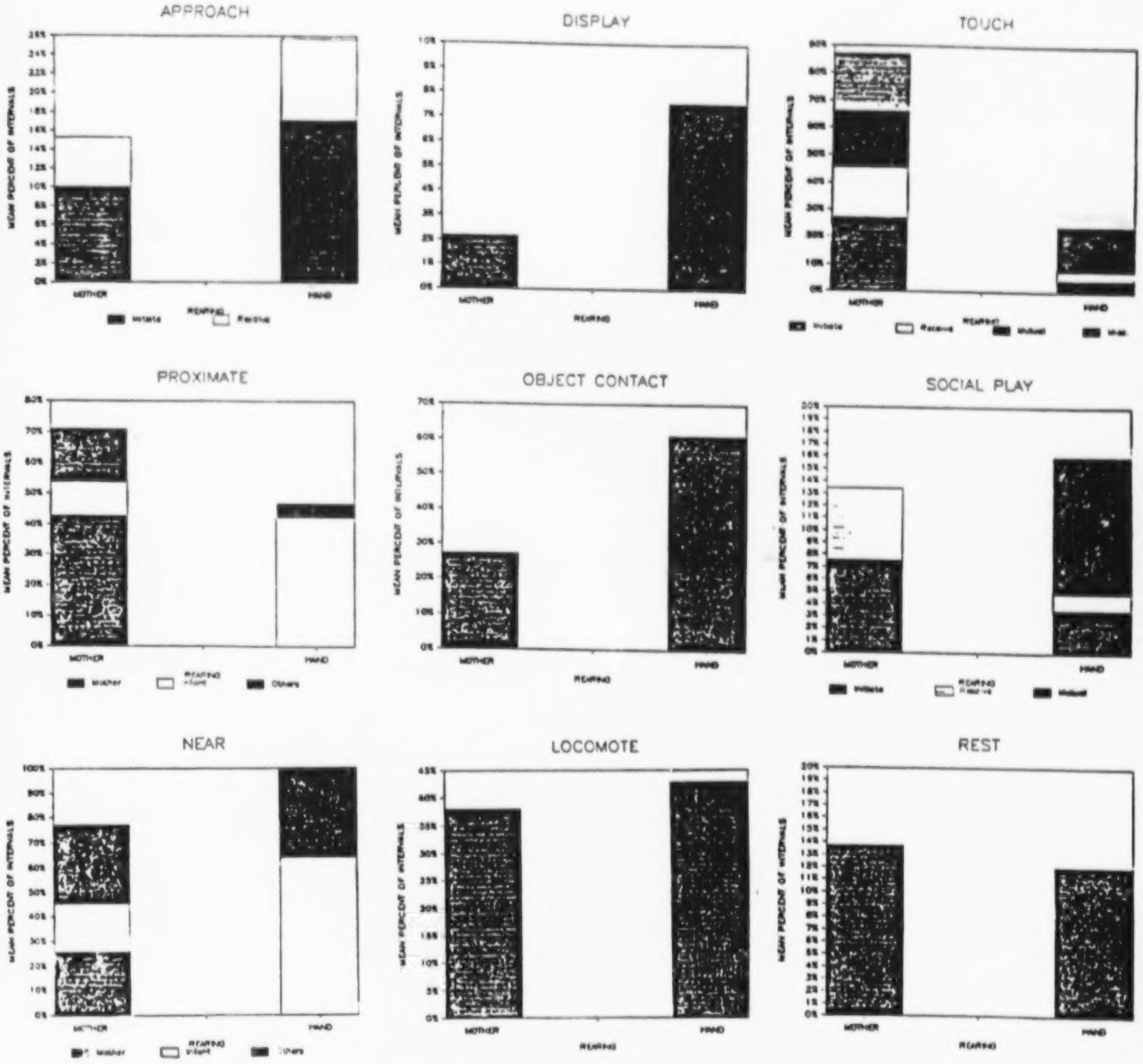
SEXUAL BEHAVIOR: Auto- or allo- inspection of genitals, copulatory positions and/or pelvic thrusting (with or without a partner).

TABLE I

APPROACH	Initiate	10.00%	17.00%
	Receive	5.30%	8.70%
	Total	15.30%	25.70%
PROXIMATE	Mother	42.70%	00
	Infants	11.00%	42.00%
	Others	17.30%	4.60%
	Total	71.00%	46.60%
NEAR	Mother	25.70%	00
	Infants	19.70	64.00%
	Others	31.70%	36.00%
	Total	77.10%	100.00%
TOUCH	Initiate	27.10%	4.35%
	Receive	18.70%	3.70%
	Mutual	20.20%	16.05%
	Miscellaneous	20.93%	00
	Total	86.93%	24.10%
SOCIAL PLAY	Initiate	7.50%	3.50%
	Receive	5.90%	1.40%
	Mutual	0.02%	11.05%
	Total	13.42%	15.95%
DISPLAY	Total	2.17%	7.60%
SEXUAL BEHAVIORS	Total	1.12%	1.00%
OBJECT CONTACT	Total	27.30%	61.00%
REST	Total	13.70%	12.00%
LOCOMOTE	Total	38.00%	42.75%

Olson and Gold 1985

TABLE II


APPROACH
DISPLAY
TOUCH
PROXIMATE
OBJECT CONTACT
SOCIAL PLAY
NEAR
LOCOMOTE
REST
MEAN PERCENT OF INTERVALS
MOTHER
HAND
REARING
Initiate
Receive
Mutual
Mother
Infant
Others

Regurgitation & Reingestion in Captive Gorillas
Description and Intervention

Edwin Gould & Mimi Bres, National Zoo

Direct observation of regurgitation and reingestion (r/r) of captive gorillas revealed the degree of constancy and variation of certain components. An analysis of the transitional behaviors of 3 gorillas showed that four behaviors, sit - stand - bend over - regurgitation, have the least number of alternative transitions. In comparison, the reingestion phase varies in regard to posture, manner of eating and behaviors that lead up to the regurgitation phase. The least variable transitions are those immediately prior to regurgitation. A questionnaire sampled 117 gorillas, 57 of which were captive born and 60 of which were wild born. Of 117 gorillas sampled, 81 (69 percent) regurgitate and reingest their food. This figure agrees closely with that of Loeffler (1982) who reported a rate of 62 percent r/r in a sample of 183 captive gorillas. An even higher percent of regurgitation (84 percent) is obtained if the sample includes only those animals more than 5 years old. Of 26 gorillas less than 5 years old, only 5 (19 percent) r/r. The lowest level of r/r occurs in the captive born mother reared animals. Survey results showed no sex related difference in r/r frequencies (males 85 percent, females 84 percent). In questionnaire results, the age at which r/r was first reported ranged from 2 to 6.5 years (n=9) with a median age of 3.

Extension of Daily Feeding Period with Browse

From July 1983, through January 1985, we attempted to determine the effects of browse availability on regurgitation, involving two gorillas Sylvia and Hercules. An observation period consisted of a series of five minute observation intervals spaced throughout the day, from 7:00 a.m. to 6:00 p.m. Only those days with greater than ten observations were considered for data analysis.

Gorillas were observed in both the presence and absence of browse. Browse species consisted of maple (*Acer rubrum*, *A. saccharum*, *A. plantanoides*), beech (*Fagus grandifolia*), willow (*Salix babylonica*), bamboo (*Pseudosasa japonica*), kudzu (*Pueraria hirsuta*), and mulberry (*Morus rubra*). Browse, when present, was available 24 hours per day. The cumulative daily regurgitation percentages were as followes: Sylvia - no browse, 45.8 percent (n=53 days of observation); with browse available, 11.2 percent (n=46 days); and Hercules - no browse 11.5 percent (n=23 days); with browse available, 5.7 percent (n=29 days). Provision of browse approximately doubled the daily time spent feeding, raising the total from 1 hour, 10 minutes (11 percent) to 2 hours, 48 minutes (25 percent) for Sylvia, and from 2 hours, 45 minutes (16 percent) to 3 hours, 13 minutes (29 percent) for Hercules.

HERPETOLOGY, EDZOOCATION STYLE

Jeff Swanagan
Education Director
Columbus Zoo

Herpetology may not be the discipline of highest appeal to the public, but among zoo education programs the study of reptiles and amphibians clearly ranks near the top in popularity. Many schools schedule programs during zoo visits which cover how reptiles differ from amphibians, fish, birds, and mammals. Numerous scout groups request herpetology programs to help them identify animals found locally. This is one of the merit badge requirements. No doubt, school and scout groups would also desire special programs on birds, fish, or mammals. Like several other zoos, the Columbus Zoo plans to develop special learning labs on mammals, birds, and fish to meet this growing demand for interactive hands-on programs.

Special education programs on herpetology are not new to the Columbus Zoo. They have been offered in some basic form since the zoo first started a herp collection. Initially, these programs consisted of a staff person or volunteers transporting various handlable representatives of the herp collection to a classroom or even outside for a brief hands-on presentation on or off zoo grounds. Today in zoos, there is a growing emphasis on developing special learning labs which offer a mixture of live animals and museum-style artifacts. This close-up experience with animals multiplied by the ability to actually touch them greatly increases the student visitor's desire to learn.

This multi-sensory learning strategy provides an excellent and lasting experience for the student participating in a herp program. But what experiences do we provide for the typical zoo visitor who is not in a special education program? Commonly, zoo exhibits offer the visitor only the opportunity to see and hear animals. This offers only bi-sensory learning opportunities which fall short of the full learning potential offered by a multi-sensory experience. Seldom do exhibits provide for the visitor the opportunity to utilize the haptic sense, the sense of touch, which is said to be the primary of all senses. Unfortunately, zoos have all too frequently experienced the hazardous side of the visitor's innate desire to touch the animals. Regardless of signs or barriers, some visitors find it difficult to control their urge to touch the animals. This strong desire to satisfy their haptic sense could be satisfied through positive learning experiences, but only if the exhibits offer full multi-sensory opportunities.

In the modern zoo, educators are becoming more involved on the design of exhibits which incorporate multi-sensory learning opportunities. Frequently, this is accomplished through creative graphics, signage, animal shows, and interpretive programs. Perhaps, the most innovative method of implementing the multi-sensory learning experience has been through various types of lab set-ups, such as the Columbus Zoo's new herp lab. Throughout other zoos and museums one can find numerous examples of similar learning labs utilizing multi-sensory learning experiences, i.e., Toledo Zoo, Diversity of Life; National Zoo, Herp & Bird Lab; Louisville Zoo, Meta Zoo; Cincinnati Zoo, Insect World; Chicago Field Museum. Place of Wonder; Columbus COSI, Kidspace. All of these facilities are available for both special groups and, at specific times, for the general visitors. In these facilities the visitors are offered a mixture of live animals, museum-style artifacts, and interpreters which provide for their multi-sensory needs.

The Columbus Zoo completed its herp lab in the spring of 1985. The lab is located in the Exploration Center, a renovated giraffe house. The herp lab is on the first floor opposite a bird lab which will be completed during the fall of 1985.

On the west wall of the herp lab is a colorful mural which illustrates the characteristics of reptiles and amphibians, shows overall size comparisons of interesting herps, and displays large color photographs of several herps.

On the east wall there are two 93.9cm. x 93.9cm. x 30.4cm. museum display cases that contain snake skins, turtle shells, and reptile skeletons. All are accompanied by interactive questions and answers which help guide the visitor.

The south end of the herp lab houses live reptiles and amphibians. This exhibit is designed with changeable label signs consisting of Kroy^{R}1 lettering on plexiglass, applied with velcro to a carpeted wall. Most of the herps are housed in 75.7 liter aquariums framed by a specially designed wooden wall (dimensions: 5.9m. x .33m. x 1.9m.). Each of the twelve tanks is lit by a 2.4m.Gro & Sho^{R}2 florescent tube controlled by an automatic timer. Adjacent to each aquarium, there are two outlets; one is permanantly hot, the other is connected to the timer. The remaining herps are exhbited in a 1,135.5 liter octagonal aquarium which simulates a pond environment. This large tank accomodates both deep and shallow water. Water from this large tank is filtered through a 113.5 liter glass tank which has been adapted into a large filter. Two 150 watt submersible heaters are contained in the filter which helps maintain the water temperature at 23°C. The water is then pumped from the filter to the upper level (deeper level) of the tank and trickles down a small rock island in the middle. There is a bubbler along the back which helps oxygenate and circulate the water, and prevents anerobic bacterial growth. Light is provided and controlled by a 300 watt floodlight and timer.

The back isle, located behind the live animal display tanks, contains a large scrub sink with hot and cold water and a thermostat permits control of the air temperature which is kept at about 22-23°C. The dietary components including live crickets, meal worms, wax worms, red worms, frozen smelt and brine shrimp, trout chow, xenopus chow, Spectra III^{R}3 fish food,' and fresh produce are stored in this area. Rodents are acquired from the Reptile Department when needed to feed the snakes.

Prior to the completion of the lab the Reptile Department maintained a small collection of herps that was utilized primarily by outreach and visitor contact programs. This required a significant part of the reptile staff's time. Currently, the lab area is completely cared for by adult volunteers under the supervision of the Education Department staff. The Curator of the Reptile Department makes a weekly check of the lab animals and serves as a consultant when problems arise. This both frees the reptile staff and increases the animal handler's sense of reponsibility by having them directly provide for the animals needs. This has resulted in the volunteers and Education staff having fuller knowledge of the animals which improves their presentations to the public.

After one summer of existance, the herp lab has been utilized by 1,400 day-camp students and countless visitors on weekends. The average visitor stay-time in the lab has been measured at 32 min. This is largely due to the presence of volunteers holding various herps so that the visitors can have direct contact with the animals. The lab signage stimulates increased interaction between children and adults through the use of self-guided questions. The herp lab has successfully offered a stimulating opportunity for both general visitors and school groups to learn about reptiles and amphibians by providing a complete multi-sensory environment.

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I would like to thank Dale Williams and Lynn Bird for their part in developing the herp lab.

PRODUCTS REFERED

1 Kroy^R lettering machine, Editor^R, Division of Presentation Products, Columbus, Ohio

2 Gro & Sho^R florescent tubes, produced by General Electric, Cleveland, Ohio

3 Spectra III^R fish food, division of Wardley Products Company, Inc., Seracus, New Jersey

GLADYS PORTER ZOO'S ROLE IN KEMP'S RIDLEY SEA TURTLE CONSERVATION

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The plight of Kemp's ridley sea turtle, (*Lepidochelys kempi*,) like that of the great whales, has become symbolic of the finite nature of once seemingly inexhaustible oceans which constitute more than 70% of our planet's surface.

In 1981, the U.S. Fish and Wildlife Service asked the Gladys Porter Zoo to administer the United States' field portion of the joint U.S./Mexico effort to protect and increase the production of Kemp's ridley sea turtles at their principal natal beach at Rancho Nuevo, Tamaulipas, Mexico. This international effort began in 1978. The Republic of Mexico had been monitoring the decline of Kemp's ridley since 1966. Historically speaking, the population of Kemp's ridleys has been declining at an alarming rate since the 1940's. A film made by Senor Andres Herrera in 1947 was presented by Dr. Henry Hildebrand of the University of Corpus Christi, Texas, to the American Society of Icthyologists and Herpetologists in 1961 at their annual conference. This film, fourteen years old at that time, revealed an estimated 40,000 female Kemp's ridleys on the beach at one point in time. This was the first time scientists had observed this type of massive synchronized nesting behavior. This extraordinary phenomenon is termed "arribada" or "arribazon" in Spanish. It has two literal translations; great arrival or, to put into port under stress, either of which is equally appropriate in this case. What could have appeared more stressful than thousands of chelonians clambering over one another's shells with flippers flailing and sand being tossed high into the air in every direction. Many turtles actually excavated the eggs from females which preceded them. The result was that *L. kempi* was its own worst predator at that point in time. That, needless to say, was soon to change.

By the 1960's when scientists began to study *L. kempi*, the population had already decreased at an alarming rate. In the 1960's three to five thousand turtles constituted a major arribada, according to Pritchard (1969). By the mid 1970's the flotillas had dwindled to hundreds. Today any number over 50 turtles is considered a major nesting day at the Rancho Nuevo sanctuary. What factors have driven this once common species to the brink of extinction? A flourishing trade in hides popular for boots, belts and handbags, meat, eggs, plus oil for cosmetics and incidental and deliberate catching by fishermen have all combined to this end result. There are probably less than 800 nesting female ridleys left and more conservative estimates cite a number at 500 or less. Several conservation agencies and groups are currently involved in the fight to save L. kempi and to recover its numbers. Their hope is to recreate a viable population.

Working together in the Kemp's ridley recovery program are the Instituto Nacional de Pesca (INP) and Secretaria de Desarollo Urbano y Ecologia (SEDUE) of Mexico, the U.S. Fish and Wildlife Service (FWS), the U.S. National Park Service (NPS), the NMFS and the Gladys Porter Zoo. Also assisting are the Texas Parks and Wildlife Department (TPWD), Texas A&M University, the U.S. Navy, the U.S. Coast Guard, and the Florida Department of Natural Resources (FDNR). Three conservation organizations from the public sector, Sea Turtles, Inc., of South Padre Island, Texas, HEART (Help Endangered Animals Ridley Turtles) of Houston, Texas and the Center for Environmental Education located in Washington, D. C., have provided invaluable, continuing support to this cause.

The effort to restore L. kempi's population involves a multi-faceted plan. First and most important is the protection of the natal beach, the nesting females and their nests. This first line of protection has been accomplished by Mexico at Rancho Nuevo which is officially a protected sanctuary. Adult turtles are now very rarely killed on the beaches as a result of this active protection with patrols of armed marines, fisheries inspectors and Mexican biologists. Sadly, the remnant population is so reduced that there is nearly 100% predation of any nests left in situ. Ghost crabs, skunks, coati mundis, racoons, feral dogs, several types of birds including herons, gulls, hawks, vultures and ravens, and man are the principal predators. Because of the heavy predator load at the beach site, biologists translocate as many nests as possible to protected corrals where they are placed in specially excavated facsimile nests. These protective corrals afford a large measure of protection against the aforementioned terrestrial predation. Prior to hatching at 45 to 52 days of incubation, a small hardware cloth circle called a "corralito" (little corral) is placed on top of a nest in order to obtain accurate hatching data on each individual clutch. This data is subsequently analyzed with the hope of improving hatch rates and hatchling production at the sanctuary. Each year, for the past five years, the Gladys Porter Zoo has hired a field crew and outfitted them with practical and scientific equipment to augment the protective and biological research effort of our Mexican colleagues.

Since the U.S. contingent officially joined the program in 1978, the annual hatchling production has essentially doubled. Most of the research at the natal beach is of a practical nature and geared toward enhanced production and protection of the hatchlings. Although adult turtles are rarely slaughtered on the beaches nowadays, the poaching of eggs for the black market remains high. Despite protective measures, economically constrained agrarian people are willing to take the chance for the monetary gain. To compound the problem, these people and their ancestors have been utilizing this resource for thousands of years. With the realization that teaching ecology and conservation practices are extremely difficult, if not impossible under such circumstances, this year Mexican biologists and their U.S. counterparts invited local children, their parents and teachers to the turtle sanctuary so that they might participate in the release of thousands of baby turtles. The endeavor appeared to be a qualified success; some of the very same persons who are the local egg thieves were sincerely shocked to find out that the biologists were actually trying to save turtles instead of selling the eggs themselves. Now they are convinced that we are just crazy! With this modest success, we plan to expand our program to all the local agrarian communities in the area of the sanctuary next season. Perhaps we can effect change through the children.

Other measures being undertaken include an experimental attempt to imprint between two to three thousand hatchlings each year with Padre Island National Seashore, just south of Corpus Christi, Texas. Eggs for this experiment are collected by Gladys Porter Zoo personnel and Mexican biologists directly from the cloacas of ovipositing females into sterile, transparent, USDA approved 100% virgin polyethelyene bags. They never contact Rancho Nuevo sand. They are transported back to the base camp where they are packed into styrofoam boxes in sand from Padre Island National Seashore. Once the eggs are collected and all the permits are in order, they are flown to Padre Island to complete their incubation and experimental imprinting. After hatching many of the turtles are then shipped to Galveston National Marine Fisheries Laboratories for a year of headstarting prior to their release to the wild. Ideally these turtles will return to Padre Island and establish a second nesting beach, however, even if they return to Rancho Nuevo instead, our ultimate goal of increasing the population of adult turtles will have been realized. One of the most difficult aspects of this program is that measurable results are a long time in coming. Some experts estimate the age of sexual maturity of L. kempi at fifteen or more years. In 1984, encouraging news was received from the Cayman Island turtle farm. Farm-reared six year old Kemp's ridleys had nested and laid fertile eggs. Optomistically, anytime now we may see the fruits of our labors beginning to appear on the beaches of South Texas or perhaps Rancho Nuevo. At the very least the 1500 or so hatchlings released each year represent a shot in the arm to bolster the gradually decreasing wild population.

Some experts estimate a one percent survival rate for hatchling L.kempi, while others estimate a more conservative one-half of one percent. Given these estimates for the years

1978 through 1985, inclusive, the 347,448 hatchlings liberated would represent 3,477 or 1,738 adult turtles. I previously enumerated some of the terrestrial and aerial species which are predacious on L. kempi hatchlings and nests. If the hatchlings are fortunate enough to survive the gauntlet and reach the water they then become prey for a variety of carnivorous fish species. Sharks appear to be the primary predator of adult L. kempi. On occasion, gravely injured females occasionally haul out and attempt to nest. Headstarted turtles recovered from shrimp trawlers off of Louisiana demonstrated that the turtles were thriving and socially facilitating with their wild cohorts. The headstart program has released turtles since 1978.

Additional measures being undertaken include super headstarting some turtles beyond the first year. These turtles are placed in several marine aquaria or zoos for potential future brood stock and potential captive breeding efforts.

In 1985 we saw a decrease of perhaps seventy adult nesting females for this season. Exactly what this means is not totally clear. We have seen some recruitment to the population over the years, but from which years? Incidental catch by shrimp trawlers and other fishermen continue to impact the remaining population. Perhaps the lower number of nesting turtles this year correlates with the early 1960's when virtually all the eggs were taken for sale in the food market. Many hypotheses can be formulated with regard to this question.

The National Marine Fisheries Service has worked long and hard on the development of a device which is called the TED or Turtle Excluder Device. This piece of equipment is placed in the neck of a shrimp trawl net and as its name implies it effectively excludes turtles. Most fishermen consider sea turtles to be a costly nuisance in that they damage nets and foul gear. Very rarely do U.S. fishermen deliberately capture turtles. The TED is also sometimes called a "trawling efficiency device" in that it can be constructed to exclude animals of any given size, thus reducing the catch of what fishermen term trash fish or animals which must be manually separated from the shrimp catch. In 1985, Mexico's Instituto Nacional de la Pesca biologists, in cooperation with the U.S. National Marine Fisheries Service personnel gave two TED demonstrations to local government officials and fishing cooperatives on the sea turtle nesting beach on the western coast of Mexico. Plans are currently underway for similar demonstrations for the Southern Gulf of Mexico fleets which directly impact the remnant breeding population of L. kempi.

The continuing fight to save Kemp's ridley represents an heroic effort on the part of many agencies and individuals. I feel it is only proper to mention a few of the individuals who have persevered the sometimes seemingly insurmountable problems of a multinational, multiagency conservation effort! They include Dr. Rene Millan Marquez of the Instituto Nacional de la Pesca of Mexico, Jack Woody and the late Dr. Duke Campbell of the U.S. Fish and Wildlife Service. Dr. Peter C. H. Pritchard of the Florida Audobon Society, Dearl Adams of Brownsville, Texas, Carole Allen of HEART, Dr. Fred Berry, Dr. Ed Klima, and Dr. Charles Caillomet, Jr. of the National Marine Fisheries Service and Milford R. Fletcher just to name a few of the many dedicated persons involved. Last and certainly not least, the Gladys Porter Zoo has dedicated its personnel and resources to the fight to conserve Kemp's ridley!

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HUSBANDRY OF TADPOLES OF THE DYEING ARROW-POISON FROG, DENDROBATES TINCTORIUS

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The Cleveland Aquarium

The Dyeing Arrow-Poison frogs (Dendrobates tinctorius) at the Cleveland Aquarium began breeding in October of 1984. Initial attempts to incubate eggs and raise tadpoles were largely unsuccessful: of a total of 49 eggs deposited in five clutches during the first phase of the breeding project, only eight tadpoles hatched; of these, only two survived until the end of metamorphosis, both of these dying within a few days of hauling out of the water. The second phase of the breeding project, beginning in February of this year and extending to the present, has produced more encouraging results: from a total of 30 eggs deposited in five clutches, we currently have (as of 17 August) seven froglets and two tadpoles. This report summarizes the modifications in tadpole husbandry implemented in the second phase of the breeding project and updates the progress report presented at the 1985 AAZPA Great Lakes Regional Conference (Emmer, 1985).

Phase II: A Review

The Arrow-Poison frog exhibit tank is constructed of plywood and measures 122 cm x 91 cm x 76 cm high and has a glass viewing window 76 cm x 46 cm high. The exhibit contains a waterfall which flows into a small, shallow pool; the waterfall is driven by a small submersible centrifugal water pump located behind the waterfall rockwork. The tank is heavily planted with climbing fig and bromeliads. The tank lid consists of a wooden frame covered with plastic flyscreen and a layer of plastic food wrap. Illumination is provided by six 4-foot Vita-Lite fluorescent bulbs. The exhibit is maintained on a 10L:14D photoperiod at 23-26°C.

The exhibit contains 15 frogs: three D. tinctorius (one male and two females), seven D. auratus, four D. reticulatus and one Phyllobates (species undetermined).

The frogs' diet consists of pinhead crickets, wingless fruit flies, ants and springtails. Crickets or fruit flies dusted with Vionate powder are offered every other week to provide a vitamin/mineral supplement.

A breeding hut is situated on top of the water pump compartment lid behind the waterfall and out of public view. The hut consists of the bottom half of a plastic gallon milk jug (painted dark brown with epoxy paint), inverted and placed over a "water bed", a petri dish which is partially filled with water and contains a plastic plant leaf, the base of which is submerged, while the tip is above water and overhangs the dish rim; a small stone placed on the submerged leaf base stabilizes the leaf, enabling frogs to climb aboard to deposit or fertilize eggs without flipping the leaf out of the dish. (See Figure 1.) Two small holes in the hut provide the frogs access to the interior.

Previous to the installation of the breeding hut, egg-laying occurred on leaves of several of the larger bromeliads; since installation of the hut, virtually all egg-laying has occurred on the plastic leaf inside the hut. Evaporation of water from the petri dish maintains a high level of humidity inside the hut, preventing dehydration of eggs. (Two well-hidden clutches deposited on bromeliad leaves became severely dehydrated by the time they were discovered; virtually all of the eggs subsequently went bad.)

When a clutch of eggs is deposited on the plastic leaf, the petri dish setup is transferred as is to a small (8 L) aquarium for incubation. The water level in the dish is adjusted so that the water line just merges with the bottom of the jelly mass surrounding the eggs (as in Figure 1). The bottom of the incubation tank is covered with a thin layer of water, and a wire screen lid overlaid with a layer of plastic food wrap is placed on the tank top. (This type of lid, used also with the hatching, rearing, metamorphosis and holding tanks described below, as well as with the exhibit tank, serves to maximize humidity within the tanks and minimize exposure of the animals to air pollutants such as paint fumes and disinfectants; also, judging from the apparently normal growth and development of the frogs, the lid transmits enough UV light to permit normal vitamin D metabolism (see Miller, 1984).) The clutch is then left undisturbed, except for removal of bad eggs, until hatching begins approximately two weeks later.

As many hatchling tadpoles have difficulty wriggling out of the jelly into the petri dish pool, the plastic leaf is transferred to another small aquarium (the hatching tank) as soon as the first tadpole breaks through its egg capsule. The leaf is placed flat on the bottom of the aquarium, and water is carefully added until the jelly mass is just submerged. The water is then tinted light blue with a dilute malachite green/methylene blue solution to protect the tadpoles against fungus attack, to which they are extremely susceptible. This setup is then left undisturbed until all the tadpoles have hatched and escaped from the jelly.

Once all the tadpoles are free of the jelly, they are transferred to separate 250 ml beakers, as they tend to be cannibalistic. (As young tadpoles do not begin feeding until a few days after hatching, they can safely be left together for the few days normally required for all the tadpoles to hatch.) The tadpoles are transferred daily to clean beakers filled with aged aquarium water; their water is treated with the malachite green/methylene blue solution each day until two days after they have begun eating, and thereafter only if fungus appears. (A plain malachite green solution was used successfully with the most recent batch of tadpoles, suggesting that concomitant use of methylene blue may not be required.)

The tadpoles are fed frozen brine shrimp, live white worms (Enchytraeus sp.) and flake fish food. A small pinch of Vionate powder is added to each beaker once a week. (During the first phase of the breeding project, tadpoles were sometimes fed frozen Daphnia. However, one or another of the tadpoles occasionally developed a large intestinal gas bubble overnight, causing the tadpole to float at the surface, in obvious distress. The bubbles usually disappeared within 24 hours with no apparent aftereffects, but one tadpole died. It is suspected that the source of the intestinal gas was minute air bubbles trapped beneath Daphnia carapaces; whether or not this explanation is correct, the condition has not recurred since frozen Daphnia was deleted from the tadpoles' diet.) The beakers are kept in a rearing tank, which is simply a 40 L aquarium covered with a lid as described above.

The tadpoles' hind limb buds become visible at approximately one month post-hatch; forelegs sprout a few weeks later, first the right, then the left. Once its left foreleg emerges, a tadpole is transferred to a metamorphosis tank, an 80 L aquarium set at a slight tilt, with a shallow pool of water (approximately one cm deep) at the lower end and a carpet of moistened paper towel, along with several plastic plant leaves to provide cover, at the upper end. The tank is covered with a lid as described above; illumination is provided by two 4-foot Vita-Lites suspended 20 cm above the tank.

Within one week, the tiny frogs haul out of the water, still possessing short tails; a few days later, they begin feeding. Unlike _D. auratus_ froglets, which are of similar size and can be fed wingless fruit flies from the start, young Dyeing Arrow-Poison frogs initially ignore the flies, pursuing only the much smaller springtails. However, within several days they begin eating fruit flies and pinhead crickets as well; within a few weeks, they can handle small ants, too. (As mentioned above, in the first phase of the breeding project, two froglets died shortly after coming ashore. The animals never showed the slightest interest in eating fruit flies, crickets or _Tribolium_ beetle larvae. This, in conjunction with occasional awkward yawning movements of the jaws observed in both frogs, suggested that the frogs' jaws had developed abnormally, perhaps due to a dietary deficiency in calcium, prohibiting normal feeding. The frogs produced in Phase II, however, behaved in like fashion until small springtails (less than ½ the size of fruit flies) were offered, at which time the tiny insects were quickly lapped up by the hungry frogs. It thus appears that the Phase I froglets refused to eat simply because they were not offered small enough insect prey. A diet of very small insects therefore appears to be of critical importance during Dyeing Arrow-Poison frogs' first few meals.)

The frogs quickly put on weight if fed every day or two; within a couple of weeks they are ready for transfer to a holding tank, a 40 L aquarium containing wet aquarium gravel or potting soil planted with wandering fig, a few plastic plant leaves and a petri dish pool of water. Lighting is the same as for the metamorphosis tank, as is the tank cover. A 40 L holding tank can comfortably support four or five small frogs; if overcrowded, the animals appear stressed and may begin to lose weight.

Phase II: Success At Last

As of 17 August, ten clutches of _D. tinctorius_ eggs have been deposited by our breeding pair (only the dominant female is believed to have deposited eggs). (See Table I.) From the five clutches deposited during Phase II, 11 tadpoles have survived through metamorphosis. One had a deformed mouth and had no left foreleg; it was eventually euthanized as it was slowly starving. Another froglet died from dehydration the first night after transfer to a rearing tank which lacked a petri dish pool. Two frogs drowned in a 2 cm deep pool of water in one of the rearing tanks. (Our young frogs are no longer exposed to water any deeper than shoulder height of a sitting frog.) The other seven frogs, along with two month-old tadpoles, are eating well and growing rapidly.

Now that the major problems in breeding and raising the Dyeing Arrow-Poison frog have been solved, it appears that the techniques used in propagating this species may be applicable to many, if not most of the species in the genus

Dendrobates; all three species on display in our Arrow-Poison frog exhibit have now been successfully bred using these methods (although the oldest *D. reticulatus* are still only tadpoles). Hopefully, captive breeding of all the members of this colorful genus will someday become routine, thus ensuring their survival in captivity, if not in the wild.

Acknowledgements

Thanks to Dan Moreno (Cleveland Aquarium) for providing the frogs with springtails, which had overrun his Madagascar Hissing Roach culture; to Dr. Sonja Teraguchi (Cleveland Museum of Natural History), who assured us that what we thought were springtails were indeed springtails; and finally, to Joseph V. Ryckman and Claudia M. Rozuk, through whose generosity the Arrow-Poison Frog exhibit was funded and the breeding project was made possible.

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Table I. Breeding record of Dyeing Arrow-Poison Frog breeding pair at the Cleveland Aquarium. (Note: A clutch of eggs deposited on 1 April 1985 was previously reported as belonging to D. tinctorius (Emmer, 1985); however, the eggs were in fact those of D. auratus, as later evidenced by the coloration that developed in the tadpoles during metamorphosis.)

Date	Clutch Size
15 Oct 1984	6 eggs
25 Nov	13
26 Dec	7
7 Feb 1985	9
26 Feb	14
14 Mar	8
22 Mar	11
5 May	4
12 Jun	2
7 Jul*	5

*Verification that this clutch is indeed D. tinctorius awaits metamorphosis of the tadpoles.

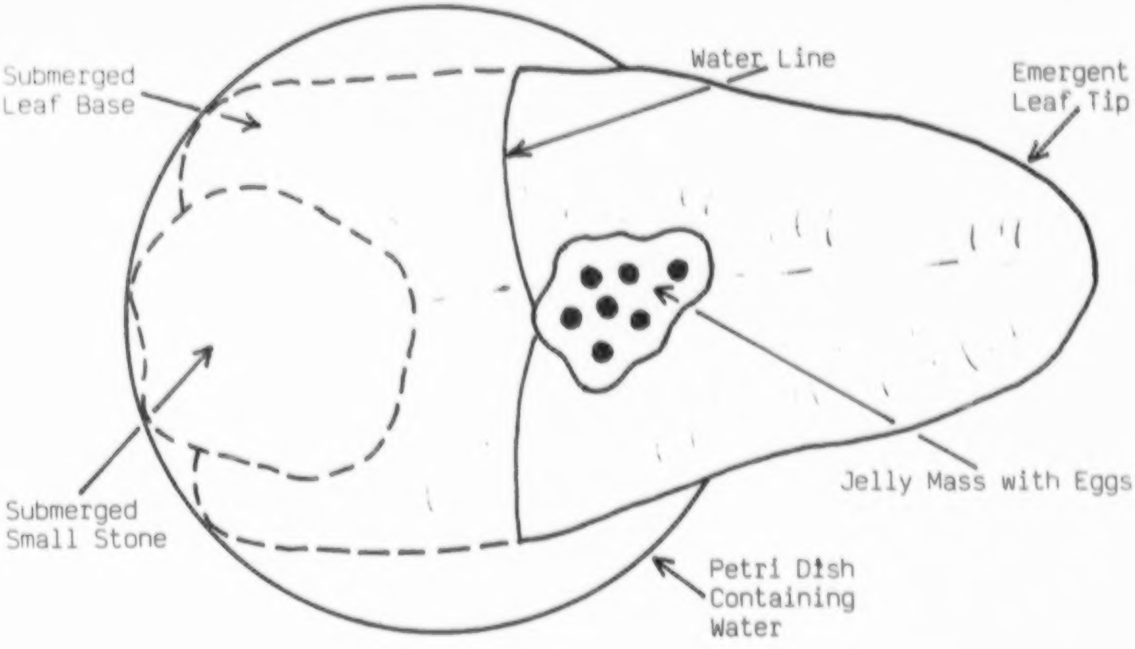
Submerged Leaf Base
Water Line
Emergent Leaf Tip
Jelly Mass with Eggs
Submerged Small Stone
Petri Dish Containing Water

Figure 1. Arrow-Poison frog "water bed", located inside the breeding hut. (Actual size.)

New York's Real Jungle:

The Botanical Development of JungleWorld

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New York Zoological Society

Sunlight filters to the ground through a textural mosaic of lush foliage. The damp air is sweetly scented by nectar and pollen. Enveloping shades of green are punctuated by bright orchids, hibiscus, and orange jasmine and the darting movements of brillantly colored birds. An agile white-handed gibbon swings through the dappled sunlight, announcing its territory with a hooting call. Plant, animal, and mineral meld into a unified sensory experience. These are the sights, sounds, and smells of a tropical jungle... in the Bronx.

Under nearly one acre of glass, the New York Zoological Society's new JungleWorld introduces visitors to the rainforest, mangrove swamp, and scrub forest of Asia - a living tribute to the vanishing tropical ecosystems of the world. Each habitat has its own hydrological, geological, botanical, and zoological features. The objective was to recreate a series of tropical Asian environments for animals, plants, and people that would attain a new level of research, conservation, and education.

JungleWorld is a brick and masonary building sited at the Southeast corner of the Bronx Zoo in an, approximately, east/west orientation. The roof is entirely glazed with single pane, pebbled, reinforced glass with a solar transmittance of 89%. Climate control is achieved through a forced air system utilizing oil-fired boilers for heat and hot water and a chiller-absorber for cooling. Passive ventilation is achieved by regulating automatic, eave located vents during temperate weather conditions.

The approach toward planning and implementing the plantings in JungleWorld was guided by two objectives: the primary objective of the exhibit, as stated above, and the botanical collection policy of the Society. Under "Acquisitions", the policy states: "...obtain plants for use in and around animal exhibits, both indoors and out, that are, to the extent feasable, integral to the prevailing exhibit theme". Based on these guidelines, JungleWorld was to be as botanically realistic as possible. Fortunately, the installation posed few limitations to growing plants, although the presence of forced air climate control left me with a pang of insecurity.

The first step in planning the exhibit design and compiling a list of appropriate plants was to determine the critical habitat of the exhibit animals and the key indicator plants of those habitats. The key indicator plants are those that give the habitat its physical character and/or provide for the particular needs of the animals present. A brief survey of the literature and consultation with staff zoologists were most useful in this regard.

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Plants were selected from the literature as 'key' based on the following criteria: abundance; physical prominence or importance in the vegetative texture of the habitat; importance to the exhibited animal. The scrub forest and mangrove swamp are so narrowly defined as habitats that determining key indicator plants was an easy task. The rainforest habitat, a broad definition, required more sorting and selection from vast lists of unknown latin binomials. In the end, this plant list was large and often unusable due to plant availability.

The key indicator plants for use in JungleWorld were further edited and others added based on the following criteria of desirability: toxicity; durability; special educational attributes; aesthetics. The final plant list for JungleWorld was determined by cross-referencing the key indicator and desirability criteria. For example, some plants included on the list were of particular educational significance, such as *Rafflesia Arnoldii*, the world's largest single flower. Certain key indicator plants had to be excluded from the list because of their particular growing requirements, such as certain halophytes associated with the mangrove swamp habitat.

Exhibit designs on paper consisted of plan views showing the locations of the major landscape components. The locations of major plants were determined by the following criteria: proximity to artificial elements; spatial limitations; proximity to walls; sight lines; camouflage; predicted spatial use by animals; logic according to habitat physiognomy; aesthetics. Detailed design features were based on photo-references of actual scenes having similarity to a particular portion of JungleWorld and the microclimate at that location. No plans were executed to show the exact locations of the lesser landscape elements in the rainforest landscape such as groundcover, vines, epiphytes, etc. These landscape elements were quantified by a determination of the space available and the percentage of that space devoted to particular plants. The percentage was determined by the relative importance of the plant to the overall habitat - key indicator. These plants were then acquired in large groups for mass planting. This design style necessitated a great deal of on-site supervision and plant placement.

Implementing the plans began with the quest for plants taken from a list so meticulously put together; a process, for the plantsmen, of fun and frustration. The first step was to amend the plant list with alternates to compensate, if necessary, for the esoteric nature of the list. Alternate plants had to meet a somewhat less stringent level of integrity relative to our collection policy. In certain cases, however, I made note of those plants that, if unobtainable, would significantly reduce the botanical integrity of the exhibit and decided to pursue those with diligence.

The selection of a nurseryman was based upon their references, storage capacity, their understanding of our special needs and

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their flexibility in meeting those needs. Our supplier, then, worked for us as a grower, broker, storage center, and shipper all in one. Three personal visits were made to the nursery during the plant acquisition and acclimatization period. Many of the plants we used were not acclimatized and some were shipped balled and burlapped straight from the field. We could afford to do this because the growing conditions in JungleWorld are such that acclimatization was not necessary. In addition, we did not have the time to acclimatize all the plant material.

Each order of plants was thoroughly discussed over the telephone once the supplier received the order. It was possible during these discussions to reiterate the importance of particular species and clarify unusual specifications. Since it was impossible to personally inspect each order during the initial acquisition period, the supplier sent a continuous stream of photographs showing important plants for my approval. Formal approval of plants was given after personal inspection at which time firm shipping dates were scheduled.

During the plant acquisition period, plans were being laid to provide for our soil and irrigation needs. The John Innes soil mix is commonly used in Britain and has stood the test of time. It differs from commercially prepared mixes in that it calls for the use of field soil. It was originally chosen for economy and longevity. Drip irrigation was a logical choice for exhibit spaces containing irregularly shaped planting pockets containing plants of all shapes and sizes. Drip irrigation puts water only where it is needed, can be operated during visitor hours, is easily controlled, and easily hidden from view.

Our first task in the exhibit space was to test the planter drains. All planters are drained with 4" PVC into a drain field or exhibit pool. Planter bottoms were filled with 3/4" round stone or, in difficult to reach planters, styrofoam packing. Drainage depths were calculated at a ratio of 1/6 by planter depth, not to exceed 12 inches. Before adding soil mix, drainage material was covered with soil seperating cloth to restrict the movement of soil into the drainage area.

The John Innes soil mix proved to be a disaster due to excessive handling which destroyed its texture. A commercially prepared, prepackaged, soilless mix was substituted. This mix, composed mainly of composted pine bark with a bulk density of 22 lbs./cubic foot, has proved easy to work with and, to date, a good growing medium. This mix was installed in planting areas to a depth of 3/4 the entire area prior to planting. At this time, many of the planters were connected with metal sleeves so that irrigation tubing could be installed between them without being visible.

At the time plant deliveries began to arrive, JungleWorld's building shell had been completed for many years leaving only a 7'X 7' opening as an access point for plants. There were other access points, but they were even smaller. How to get 30 foot plants in 6'X 6' boxes into such a small opening? None of the crew had experience in such an undertaking - we proceeded one small step at a time.

Several techniques and pieces of equipment were used to move plants. The equipment list consisted of one 3 ton capacity fork-lift, one wench truck of similar capacity, one 2½ ton capacity pallet jack, two 1½ ton capacity chain hoists, and a home-made trunk cradle on a dolly. We also made use of several 3/4" bull lines and nylon straps. The heavy equipment was used to unload trucks and move large plants to the entry door of the building. All large plants were moved within the building using a system of ramps, constructed of plywood, 2"X 10" planks, and soil bags for support, and the pallet jack and/or chain hoists. Trees and other large plants were lifted into hard to reach planting areas by chain hoists and guy ropes. All of the large plant moving, in this case, was particularly labor intensive.

The largest plants were installed first and smaller plants, accordingly, there after until each exhibit space was complete. Too enhance the dimensions of the planting and amplify a feeling of encroaching vegetation, all plants, even large trees, were leaned over pathways, into views, and away from walls to avoid shadows. Most of the tenets of good landscape design were cast aside in an attempt to achieve more realism; it's hard to break old habits. Using field descriptions, textbook photographs, borrowed and personal slides as inspiration, the jungle began to take shape.

Understory and secondary plants were placed by sight as dictated by a particular location and the ambience created by the larger plants. Broad, assymetrical colonies of single species which gradually integrated and disappeared into other colonies of different plants were the result of this approach. Vines, ferns, and epiphytes were salted into the setting wherever a spot presented itself. An important component of the secondary vegetation, one often left out of traditional plantings, is grass. Limitations in the amount of light are often the cause of failure with these plants in an indoor facility, but they are worth a try if the appropriate plants can be obtained. Grasses lend an additional sense of realism and weediness if used in areas representing ecotones and pioneer communities. To achieve the final threshold of realism and for utility, dead material was added to blur the lines between real and artificial, create the sense of an evolving, living habitat, and provide for the perching needs of birds and mammals.

The final step in completing the project, not to mention the small gallery spaces, was the installation of the drip irrigation system. With sleeves installed between the planters, it was an easy task to install the 16mm supply lines. Attached to the supply lines are 5mm spaghetti tubes which form a web of irrigation lines throughout most of the planters. One gallon per hour, pressure-regulated drip heads are used throughout. Drip irrigation takes care of approximately 50% of our watering needs while the rest is done by hand. The entire irrigation system is composed of 7 control stations, each with a single, 7 day selenoid valve controller, filter, and pressure control regulator.

The botany of JungleWorld is diverse and subtle. On each visit, zoogoers will discover new hidden treasure; each nook and cranny is inhabited by some type of plant. Stimulating the mind as well as the senses, a visit to JungleWorld will be a one-of-a-kind experience. This new exhibit is a living tribute to a remarkable, irreplaceable part of our planet.

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HORTICULTURAL CONSIDERATIONS IN THE PLANTING OF A RED PANDA EXHIBIT - CINCINNATI ZOO

David B. Ehrlinger
Cincinnati Zoo

The Cincinnati Zoo completed the construction of a red panda *Ailurus fulgens* exhibit in June, 1985. This paper will describe the exhibit and the goals of the landscape including animal needs and natural habitat representation. Discussion will continue regarding plant species used, plant acquisition, and interpretation.

The whole exhibit area encompasses approximately 4,225 square meters (40,000 sq. ft.) with the animal display being composed of two areas 183 square meters (2,025 sq. ft.) each, adjacent to each other, and separated by an artificial rock barrier. Each exhibit contains a pool approximately 14 square meters (160 sq. ft.). Public walkways meander along the exhibit offering three elevated viewing areas. An artificial stream appears to flow through one section of the landscape into the exhibit pools. Landscape planting along with natural and artificial rockwork provide a naturalistic appearance along the walkways, viewing areas, and inside animal exhibits. Nest boxes within the exhibits are hidden by planting.

One of the most significant requirements of red pandas are trees large enough for the animals to climb and sleep in. These also provide shade and generally a cooler microclimate in the exhibit. We planted a large Goldenrain tree *Koelreuteria paniculata* 7.5 meters (25 ft.) in height and a Chinese elm *Ulmus parvifolia*, similar in size, in each of the two adjacent exhibit areas along with a Japanese Red Pine, *Pinus densiflora*, 4.5 meters (15 ft.) in height, in each. A relatively large turf area provides opportunity for grazing. Our turf consists of bluegrass *Poa pratensis* sod, overseeded with perennial ryegrass *Lolium perenne* and tall fescue *Festuca arundinaceae* cultivars. We also added a number of white clover *Trifolium repens* and nut sedge *Cyperus esculentus* plants to give a more natural appearance to the sod.

Other herbaceous plants, shrubs and trees were included to provide additional cover and possible forage. Of course toxic plants were avoided. Our exhibit has incorporated larger quantities of small trees and shrubs than is typical for most red panda exhibits in order to provide a more natural forested appearance, and give additional visual screening.

Red pandas today inhabit a vast range of montane forests in central Asia extending along the eastern foothills of the Himalayas from Nepal to southern China. Writers from Teddy Roosevelt to Miles Roberts have provided entrancing descriptions of this remote and biologically rich region. Unfortunately, like most of the East Asian temperate forest, even these remote montane forests are being rapidly deforested as human needs for lumber, fuel, and livestock pasture reach higher in elevation.

After reading and research it soon became obvious that most of the indigenous plant species are not commercially available in larger sizes, quantities, or simply not at all. Even worse, montane species are adapted to cool summers and not to our often dry midwest summers. Many of these species really are not even sufficiently cold hardy either. Whenever indigenous montane species were either not available or suitable for cultivation, it was decided to utilize plants from China because of its geographical proximity. Many of our temperate ornamental plants are Chinese in origin, are well-adapted to our midwest climate and available from commercial nurseries.

Botanical gardens and nurseries that specialize in unusual species generally can only provide small plants and often only small quantities. For large sized plants in large quantities one often has to depend on commercial nurseries which have relatively smaller selections to offer than one desires. Sometimes the naturally occurring species are not available, only cultivars that may have selected qualities such as compact growth habit or unusual flowering that are not desirable in a naturalistic landscape.

Beginning in 1983 we began to procure Chinese species from nurseries, botanical gardens, arboreta, universities, and private individuals. These ranged in size from seeds to four multiple-trunked 4-5 meter tall (14-17 foot) Lacebark pines Pinus bungeana with 1 meter (39 inch) root balls. We also located Chinese species on the Zoo grounds that we could transplant by hand or with a tree spade.

The major goal of the exhibit planting and interpretation, beyond meeting the needs of the animals is representing the natural habitat of the red pandas. This vegetative habitat is characterized by a subalpine mixed coniferous-deciduous forest with bamboo and other broadleaf evergreen species being frequent understory species. In representing this forest, deciduous species were planted including; indigenous Chinese paper birth Betula albo-sinensis, Sichuan white birch Betula platyphylla szechuanica, and David maple Acer davidii. Montane coniferous species were not available so lowland Chinese species were used including; Lacebark pine Pinus bungeana, Japanese red pine Pinus densiflora, and Chinese juniper Juniperus chinensis 'Keteleeri'. In addition, as a background evergreen screen large Eastern white pines Pinus strobus and Norway spruce Picea abies have been planted.

Bamboo is a most important plant to use in a landscape representing red panda habitat. We planted a grove of bamboo behind the exhibit so that in time it will be conspicuous to the public. We also have "planted" small groves of dead bamboo culms in the exhibit to resemble bamboo groves that have flowered, seeded, and died in recent years in China. We have also planted two species that resemble bamboo; Heavenly bamboo *Nandina domestica* and Arctic blue leaf willow *Salix purpurea* 'Nana'. Outside the exhibit bamboos are planted in several various landscape functions.

The only montane species that we were able to obtain is Umbrella bamboo *Sinarundinaria murielae*. Additionally, several species of the lowland *Phyllostachys* species have been planted including; Large-node bamboo *Phyllostachys nidularia*, which is found at somewhat lower elevations than red panda range, Yellow-groove bamboo *Phyllostachys aureosulcata*, and *Phyllostachys nuda*. Several small groves of the U.S.A. native, Giant cane bamboo *Arundinaria gigantea*, were also planted for forage and as a screen.

A major goal of the exhibit planting is to portray the diversity of plant species and communities. We have planted over one hundred species in sites ranging from simulated montane rock outcrops to ponds and from sunny exposures to forested shade. Another goal is to demonstrate some of the plant genera that are endemic to East Asia including *Koelreuteria*, *Cercidiphyllum*, and *Phellodendron*. On the other hand many species are similar to and related to North American species. Such analogs include Chinese redbud *Cercis chinensis*, Kousa dogwood *Cornus kousa chinensis*, and Chinese wisteria *Wisteria sinensis*. Another important theme is to include species that are endangered and threatened in the wild. Some of these have been cultivated by the Chinese for centuries for their beauty and economic uses. Several of these species include; the well known Ginkgo *Ginkgo biloba*. Lily magnolia *Magnolia liliflora* (*M. quinquepeta*) and Hardy rubber tree *Eucommia ulmoides*. Many other plant species have long been cultivated as ornamentals in the long history of Chinese civilization. Many of these subsequently have been introduced into the West for their beauty and have enriched our landscapes.

The best source of information on the vegetation of this area is found in *The Giant Pandas of Wolong*, (George Schaller, et al.).

Following is a listing of plant species according to planting and interpretive themes, as well as landscape functions.

RED PANDA EXHIBIT - CINCINNATI ZOO
PLANT LIST ACCORDING TO PLANTING AND INTERPRETIVE THEMES AND LANDSCAPE FUNCTIONS

THEME	PLANT SPECIES		LANDSCAPE FUNCTION
	SCIENTIFIC NAME	COMMON NAME	
Natural Habitat	Betula albo-sinensis	Chinese white birch	Specimen, screen
	Betula platyphylla szechuanica	Chinese paper birch	Specimen, screen
	Acer davidii	David maple	Specimen
	Pinus bungeana	Lacebark pine	Specimen
	Pinus densiflora	Japanese red pine	Specimen
	Cotoneaster dammeri	Bearberry Cotoneaster	Groundcover
	Viburnum rhytidophyllum	Leatherleaf Viburnum	Screen
	Sinarundinaria murielae	Umbrella bamboo	Specimen
	Phyllostachys nidularia	Large-node bamboo	Specimen
	Phyllostachys aureosulcata	Yellow-groove bamboo	Screen
East Asian Endemic genera	Koelreuteria paniculata	Goldenrain tree	Panda climbing tree, specimen
	Cudrania tricuspidata	Silkworm tree	Barrier
	Hovenia dulcis	Raisin tree	Screen
	Decaisnea fargesii		Specimen shrub
Analogs to North American species	Cornus kousa chinensis	Kousa dogwood	Specimen screen
	Chionanthus retusus	Chinese fringetree	Specimen shrub
	Viburnum sargentii	Sargent Viburnum	Specimen shrub, screen
	Euonymus bungeanus	Winterberry Euonymus	Screen
	Wisteria sinensis	Chinese Wisteria	Vine
	Rubus cockburnianus		Barrier
	Clematis maximowicziana (c. paniculata)	Sweet Autumn Clematis	Vine
	Juniperus chinensis 'Keteleeri'	Keteleer Chinese juniper	Screen
Endangered and Threatened species (in the wild)	Eucommia ulmoides	Hardy rubber tree	Shade, screen
	Magnolia liliflora	Lily Magnolia	Specimen
	Metasequoia glyptostroboides	Dawn redwood	Screen
	Ginko biloba	Ginko	Shade, screen
Used economically in China	Cedrela sinensis	Toon tree	Small tree, screen
	Pistacia chinensis	Chinese Pistacia	Small tree, screen
	Phellodendron amurense	Amur cork tree	Shade tree, screen

THEME	PLANT SPECIES SCIENTIFIC NAME	COMMON NAME	LANDSCAPE FUNCTION
Commonly Used as Ornamental in North America	Euonymus alatus	Burning bush	Screen
	Ulmus parvifolia	Chinese elm	Panda perch, specimen shade
	Cotoneaster dammeri	Bearberry Cotoneaster	Groundcover
	Forsythia suspensa	Weeping Forsythia	Screen, hide exhibit walls
	Parthenocissus tricuspidata	Boston ivy	Groundcover, hide exhibit walls
	Castanea mollissima	Chinese chestnut	Shade tree
	Hosta lancifolia	Lanceleaf hosta	Perennial, groundcover
	Platycodon grandiflorus	Balloon flower	Perennial

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THE IMPACT OF CONSTRUCTION ON ESTABLISHED TREES

by

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The Woodland Park Zoo grew out of a 90-acre portion of what was once the estate of Guy Phinney. This tract of virgin douglas fir forest, aptly named Woodland Park by Mr. Phinney, lies six miles north of downtown Seattle on what is now known as Phinney Ridge. It was sold to the City of Seattle in 1899. Old-growth douglas fir had been logged before 1900. What emerged in its place was second-growth fir, native alder and big-leaf maple. With the help of the Massachusetts firm of Olmsted and Olmsted, hired by the City of Seattle to create a public park out of Guy Phinney's estate, a variety of ornamental trees were planted.

Many of the trees planted during the early decades of this century have matured into stately and valuable specimens. These are worthy to be preserved during a period of zoo renovation which began in the 1970's. Most of the naturalistic exhibits have incorporated these trees into their designs because the trees help to create the bioclimatic zones upon which the Zoo's master plan is based. The new exhibits would not have been as successful if we had been forced to start anew with only young trees.

Only time will tell the long-term effects of construction on established trees. Some died rapidly after exhibits were completed. Some have declined, showing varying effects of stress. Some are healthier than they should be, given what has happened to them.

It is my intention today to discuss some of the factors that affect a tree's ability to survive construction using the Woodland Park Zoo as an example. I also wish to offer several techniques that all zoos can use to better insure the long-term survival af their important mature trees.

The Woodland Park Zoo's Gorilla Exhibit was built around two established maple trees. One, a Norway maple, was roughly 35 feet tall. The other, a native big-leaf maple, was roughly 60 feet tall with a trunk diameter measuring about four feet.

Half the roots of these two trees were destroyed when the contractors dug a moat at the back of the exhibit within five feet of their trunks. The Norway maple also suffered from receiving about two feet of fill dirt at its base. I have no photographs of this tree because it died within a year of exhibit opening and was removed immediately.

The big-leaf maple today is barely alive. During the first spring, the gorillas peeled and ate the bark from this tree while the sweet sap was running. Before the keepers responded to the problem, 85 percent of the trunk had been girdled. This is the tree that Kiki, or male gorilla, can climb in and look all over Seattle. We have removed 90 percent of the canopy so the dead branches won't break under his weight. Fortunately, the two young sycamore trees in the exhibit are thriving. In another 25 years they may get big enough to ease the pain of the loss of the maples.

The African Savanna Exhibit was also built around two established trees, an oak and a sycamore. This exhibit houses giraffe, zebra, and springbok. Though the health of the trees has noticably declined, they remain alive and stable. They have suffered from major changes to grades, slopes, and drainage patterns. Their root zones were compacted from construction equipment and animals. A new automatic irrigation system has altered their watering regime.

The exhibit opened in the summer of 1980 and, by the end of the year, the trees were seen to be suffering. Several measures were taken during the summer of 1981 to help them survive. Because the giraffes had been fed from the tree trunks, they were always standing in the root zones. We therefore stopped feeding the giraffes at the live trees. Instead, we brought in a dead cherry tree and suspended it from a concrete pad placed on high ground. Compaction from the animals was immediately reduced. We also rototilled the top layers of the root zone to increase water infiltration and oxygen levels. In addition, we also increased the number and sizes of large stones placed at the base of the trees to make it more difficult for the animals to walk through there. And we fertilize regularly.

One of my highest priorities in the next few years is to plant another tree in the Savanna, in case we lose these two. However, today they are still alive and their health appears to be stable.

Our Swamp and Marsh Exhibit was built in the middle of a grove of mixed hardwood species including black locust, maple, horse chestnut, and elm. These trees remain healthy, though with an appropriate amount of dead wood in them to imitate a swamp very well. I consider this exhibit to be our most successful tree-filled exhibit today. One reason the trees have done so well is that the project ran out of money before an irrigation system could be installed. Sometimes trees that grow up without summer watering will die suddenly when they get it. And at times, not putting in automatic irrigation is a boon to saving trees.

Our Pheasantry Exhibit is currently under renovation. A walk-through aviary net will soon enclose five established

Norway spruce trees. A new irrigation system, grading, landscaping, and paving will all serve to alter the root zones of these trees. This is the first construction project I have had the privilege and the pain to be involved in from start to finish. I cannot tell you today that, in spite of my best efforts, these trees will live another few decades. I simply don't know.

Currently under design is a five-acre Asian tropical forest complex at the Woodland Park Zoo. It will feature elephants in addition to other Asian animals. This area is the last remaining tract of forested land in our zoo to undergo development. It is covered with a wide variety of native and ornamental trees, most of which are at or beyond maturity.

The deciduous trees on the site will remain to help further the concept of an Asian tropical forest. The approximately 30 conifers will either be transplanted out of the area or cut down to use as logs in the elephant demonstration yard. We may also use them in other exhibits, for a wide variety of purposes.

I shall have to return in ten years with an update on the survival of the trees I have discussed today. They represent an expenditure of many thousands of dollars because they were considered to be that valuable. But the questions remain unanswered. Why do some trees die a year after an exhibit opens while others remain seemingly healthy? What is tree decline and can it be reversed? What is the real value of trees to the world today and shouldn't we who are conserving wildlife be conserving our own tree resources better than we have?

This has been a rampant problem in the construction industry for years, though I don't consider construction companies to be the only ones at fault. All too often, caring people such as us who want to preserve living things set out to save a tree and in fact trumpet that fact. It becomes a major part of our exhibit design, the exhibit is built, the contractor is paid, and we're all very happy with ourselves, except of course the tree. A year later or ten years later it is dead. And we never really stop to analyze what killed it, and we never really change effectively the ways we operate.

I wish to propse five rules which, if we follow them, will help us change our ways.

Rule 1. Keep all your trees healthy by giving them the proper care. They are living biological systems that need the same things animals and humans need to survive. They need oxygen, water, light, nutrients, freedom from pests and disease, a proper temperature regime, and a little love and respect. A healthy tree will survive more stress than an unhealthy tree. So don't take your trees for granted.

Rule 2. Don't make decisions out of myth and ignorance. We all love our myths about trees. Here is a favorite one of mine: "The root system of a tree mirrors the canopy of that tree in size and shape. Therefore the drip line is all important." This I call the "dumb-bell" theory of root-shoot development, partly because lots of dumb-bells still believe it.

In fact, root systems are very irregular, occupying from two to forty times the area the canopy occupies. Researchers several years ago dug up a tree measuring 106 feet in height. It had roots running 212 feet horizontally in one direction. Most of them were in the top three feet of soil. (Clark, 1984) For lack of a better guideline, use the drip line, but please understand its limitations.

Because species differ in their responses to stress, because sites and soils cause tree roots to grow differently, and because these precious roots are invisible to us, please consult professional tree people before making decisions about exhibit designs.

Rule 3. When handed blueprints and asked to make comments, please take this task seriously. Learn to study and read blueprints well. I have heard complaints from zoo staff members that they just didn't get what they needed in their new exhibits. And yet when given the blueprints and asked to make changes during the initial design phase, they just didn't have the time.

Don't just study the item on the blueprint that is your pet peeve. Look where sewer and water lines will go, electrical vaults, support beams, overhead wires, and building foundations. I find these subjects exceedingly dull myself, except when they interfere with the trees I do care about.

Rule 4. Write clear, strict specifications into construction contracts and don't back down when contractors ask to change them. Use a whip if necessary to enforce them. If you specify nothing else, at least specify that nothing should happen within the drip line of trees. This includes trenching, driving through the area with construction equipment, parking the foreman's truck in the shade, storing supplies, soil, junk, etc. To help insure this, require contractors to erect a fence around every tree to be saved. Enforce your rules, especially in the middle of construction when the contractor who is two weeks behind goes to your boss and claims he can't meet the deadline unless the rules are changed. Believe me, everyone at the Zoo will blame you for making all those silly rules to save all those silly trees.

Include in your specs what the contractors should do about exposed root ends. Don't let them dry out. Also include what to do about cut and fill problems. Tree professionals can give you excellent guidelines to follow.

Rule 5. This rule is the last, but certainly not the least important. After the exhibit is built, protect trees from animal damage before it happens, not afterwards. I wish I could say that we at the Woodland Park Zoo have not been guilty of this. We have been guilty, and we have suffered the inevitable consequences.

It is senseless to design and build an exhibit around a large tree and then do nothing to protect it from an animal who may damage it. Remember, a tree that took 80 years to grow tall can be killed in eight minutes or less. Our responsibilities to our trees are no less serious than our responsibilities to our animals.

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THE MONKEY ISLAND EXPERIENCE

by
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When I was asked to give a paper for this session, I contemplated what we, at the National Zoological Park, have done horticulturally which might be of interest and use to others in the management of plants and animals.

I selected our Monkey Island project which was completed in April 1983 as I have been involved in that project from design through construction and during the last two and one-half years of management. I feel comfortable in discussing the attributes and shortcomings of this exhibit which I share for the benefit of those who have or are contemplating construction of an outdoor primate exhibit of similar nature.

During the past several years, I have had the good fortune to evaluate a large number of architects, landscape architects and planning engineers who specialize in zoo design and I have found many public relation pieces published by these firms contain slick color photographs of lush landscapes displaying exciting animals. These photographs depict new zoo exhibits in their early stages of completion, usually opening day, or shortly thereafter. Descriptions of proposed or recently completed projects leave much unsaid as to what that exhibit will look like in three or four years. This "opening day" syndrome only measures the success of the contractor, not the success of the exhibit. For an exhibit to be considered successful, the designated quota of animals should occupy the space for several years and this should include juvenile curiosity and play.

Well documented surveys of established successes can provide good guidance, but beware of the designer who naively believes that one grouping of plant species which has proven successful with a troop of primates in one zoo will succeed in another zoo with a different family of the same animal species. The complex interaction of animals, plants, microclimates and zoo management create individual and unique dynamics with innumerable variables.

Absolute success can never be achieved as any new animal introduced into an exhibit will possess a unique combination of behavioral characteristics that will continuously test the exhibits design parameters. As the addage states, the final judgment will be made by the high courts of history. Only time and experience are the true measure of success.

Background of Design

The idea of a Monkey Island was formalized in the Master Plan which was approved in 1972. At that time, the classical island design was conceptualized with the public viewing a family group of monkeys across a water moat. In 1980, design money was appropriated and a prominent location was selected along the main walkway through the Park. The topography of the site was steep enough to cause the design team to reevaluate the island concept of water on all sides. The new design footprint resulted in an exhibit bounded by water on one half of its perimeter and a glass wall on the other half. There was to be an underground holding facility, bunkered into the up-hill side. The land mass was to include a rock outcroping with waterfalls, large trees and a water moat wide enough to contain the animals and provide a water edge with alternate shoreline plants and open beach.

The animal species chosen to occupy this exhibit was barbary ape (Macaca sylvanus). These primates are indigenous to North Africa, including the Rock of Gibralter and the National Zoo's previous experience with these animals provided us with the knowledge that we could design this facility as a twelve month exhibit. Since barbary apes are polygamous, the exhibit was designed to ultimately house one large troop of 15-20 individuals.

It was decided that natural rock would be used and that topography, geology and landscape was to be merely suggestive of the barbary apes native habitat. Regarding plant species to be utilized a number of plants, indigenous to the Atlas Mountains of North Africa are hardy in the Washington, D. C. area, but most are rare and it was felt that even if large enough specimens could be obtained, replacement requirements would be a constant burden. Therefore, a decision was made to use readily available plant materials to maintain a green setting for the animals.

It was with these decisions and background that the architectural firm set to work to design a new Monkey Island for the National Zoo.

Planting Plan

A landscape architectural firm was sub-contracted to develop a landscape plan and as staff horticulturist I was consulted in matters of species selection and maintenance requirements. Since we had no experience exhibiting these animals with vegetation, this was going to be a learning experience for all. I might add, that from the beginning, there was a strong contingent of skeptics, who felt the monkeys would destroy all the plants in short order.

This project was my first experience working with a landscape architect (LA) on a major animal exhibit design. I had developed a number of theories about the design and management of exhibits which display animals and plants, but I had not had the opportunity to test them, so I was reluctant to make bold statements. One area that I felt strongly about then, and still do, is the plant list. Common sense dictated the more plant species used, the greater the possibility more plants will survive the methodical foraging, insatiable curiosity and sometimes wanton destruction that primates can exert on plant material. Diversity would be the key to successful management of this exhibit in a vegetated state. It is difficult to convey this concept to LA's who have not previously worked in zoo design or are not aware of the types of stress plants are subjected to in the zoo environment. Designers tend to minimize species of plants, promote design harmony through repetition and desire focal points for dramatic effects. That is to say the established aesthetic basic design principles seem to be more comfortable than venturing into the unknown. The final plant list for Monkey Island resulted in a compromise of the original LA's list which I was able to increase by a number of species, but was also reduced by the nutritionist after his review revealed several potentially toxic species.

The plant species were grouped into four categories by association and location in the exhibit; trees and shrubs, rockface, aquatics and grass mix. Large evergreen trees were included to create a better scale that would offset the rockwork mountain, offer shade to the animals and provide additional climbing structures. These trees had to be carefully placed far enough in from the outer walls so the animals would not have an escape route. Shrubs were massed to break up the land form and the remaining open areas were seeded with a grass mixture to prevent erosion. The steep rocky sides of the mountain were planted with shrubs and groundcover plants in hope that they would spread and cascade over the large boulders to soften the visual impact of this massive structure. Emphasis was placed on avoiding a stone coping as the usual transition between water and land so the moat was designed with a five foot wide planter which would retain water when the rest of the moat was drained for cleaning. This under water planter was to be filled with aquatic plants to provide variety to the exhibit and create a natural transition of water to land. Eight hardy waterlilies were placed in the middle of the water moat area, away from the turbulant water of the falls where they would be able to spread out their platters and add interest to the exhibit.

There were 979 plants of 15 species planted in the animal enclosure with a grass mixture composed of three species spread over the open areas of land.

Installation

A major concern during the construction process was the coordination of the landscape contractor's accessability to the site in relation to the proper season for planting. Fortunately, all construction work proceeded smoothly and the landscape was planted in September 1982. Because of the confining nature of the exhibit, the size of the trees specified and the distance these trees would be placed from the outside of the exhibit, the landscape contractor rented a 72 ton crane. With this crane, all excavated soil from the tree pits was removed, all topsoil was brought in and all fifteen large trees were set in place. During the course of the topsoil installation a product called Enkamat was placed three inches below the final grade. The purpose of this product was to produce an anchor into which the grass roots would grow developing a strong sod and minimize the monkey's pulling out the grass by its roots.

Roses, raspberrys, phlox, sedum and blueberrys were randomly planted around all sides of the rockwork, most were planted bare root in the crevices of the rockwork by inserting the roots then filling the crevice with planting mix. All of the aquatic plants were placed in the exhibit the following March, 1983. An irrigation system, consisting of five Toro 640 heads, with factory pre-set arcs were installed to cover the entire planted area, including the rockwork. The system was automated by a central controller and each head was on an independent timer that has now been set for each zone.

The Monkey Island Exhibit was opened to the public on 1 April, 1983. The animals were held out of the exhibit until two weeks before opening. This allowed the plants to become somewhat established through the tail end of a fall growing season, all winter and the beginning of a Spring season.

Animal Composition

The exhibit opened with four animals: one male and one female adult and two juveniles. During the past two and one-half years the adult female has produced two offspring. The total of six animals will remain constant for a while as the dominent male has been vasectomized. To preserve genetic variation, the collection will be maintained at this level for several years until new bloodlines can be introduced. The current feeling in the animal management division is to limit the troop size to ten individuals. This is less than the design quota, however, based on our experience, more apes would devastate the plants in this exhibit. In addition to the barbary apes, the moat has been stocked with bluegills (*Lepomis machrochirus*) mosquito fish (*Gambusia affinis*) and painted turtles (*Chrysemys picta*) all of which are breeding. Four about a year, a young five foot American alligator (*Alligator mississippiensis*) was a resident in the moat and along the shoreline. There is presently an oriental small clawed otter (*Aonyx cinerea*) as an interim, but the Zoo plans to replace the otter with a pair of slender-tailed meerkats (*Suricata suricatta*). To date animals, other than the barbary apes, have posed little problem in the management of the plant life.

Observations

During the first year, a number of incidences occurred which concerned us as to the future of the plant materials in the Monkey Island Exhibit. Almost immediately, the apes attacked three species of plants. The swelling buds of the blueberrys and roses seemed to be delicacies, as the animals would sit beside each plant in turn and pick off all the buds, one at a time, and pop them into their mouths, much as children eat pieces of candy. Then, as the raspberry started to leaf out, all the tender shoots were systematically devoured. Each time a plant would put out a new shoot or bud, the apes ate it until all the blueberrys, roses and raspberrys succumbed. Finally, the dead twigs were broken off and thrown at each other for amusement.

As spring turned to summer, the new growth of the aquatics began to emerge from the water moat planter and the apes, who were not supposed to like water, gingerly tiptoed into the shallow water and began to work over the shoreline plants. Starting with the cattails, which they seemed to like the best, they also destroyed the plantings of Arrow Arum, Water Canna and Giant Bulrush. For some reason, they allowed the Arrowhead and Pickeral Rush to grow. The Water Lilies being in the middle of the moat, seemed a sure bet.

Up until the fall of the first season, the trees, shrubs and grass didn't seem to be greatly disturbed. The apes were climbing throughout the trees and, with the exception of one Japanese Black Pine, which was branched low to the ground, the trees seemed to be holding their own. When the leaves of the Red Twig Dogwood started their autumn coloration the animals became interested in these plants. They broke many branches for no apparent reason and left them hang on the stem. Because this dogwood is a vigorous grower and a substantial number were originally installed, this did not affect the shrub cover, except to give it a ratty appearance.

During the winter months the condition of the large pines worsened. This may have been because the apes spent more time in them, or it could have been a cumulative effect just noticed after other plants lost their leaves; in either case, it was apparent that the animals were not consuming the foliage, but simply pulling it off and dropping it to the ground. The trees were used to a great extent by the subadults and juveniles in games of chase. In some cases, this active play would result in broken branches.

In April 1984, the first anniversary of the exhibit, a prognosis of the overall condition of the Monkey Island landscape was optimistic. All the surviving plants put out new growth. It appeared that the trees might hold their own against the apes destruction. Each tree formed vigorous new candle growth and I thought that an equalibrium may have been reached between plant and animal. There was almost a stratified layer of a lower, denuded portion of the trees, which was occupied by the apes and an upper portion where the branches were too thin to support the animals which remained green and healthy.

The phlox thrived in the rocky crevices and bloomed profusely to brighten the exhibit. The dogwoods leafed out nicely and started to thicken by developing their characteristic sucker growth and the grass species spread to create a dense naturalistic sod. The Pirkerel Rush emerged vigorously and even several cattails and arrowheads came back to life, but the animals kept the latter two cropped, never to allow them to mature. The water lilies did well the second season, increasing in size and number of blooms.

As the season progressed, the destruction by the animals seemed to have stabilized and with some plant species spreading. Of notable exception were the trees. By the end of the second summer and into the fall, the apes discovered they could occupy their time by picking the bark off the pine trees. The consequences of this behavior was disasterous to the trees; of the original fifteen trees, only one isolated individual survived into the third year.

In the spring, 1985, we overseeded several small areas with grass. These areas were thin because they were the common travel routes in and out of the exhibit holding building used daily by both animals and keepers. Another bare spot was excessively steep and which I don't believe received adequate seeding at the time of installation.

During the heat of the summer, an interesting behavior was adopted by the animals. They ventured into the water, over their heads, beyond the planter edge and began to pick and eat the waterlily buds. Thus far this behavior has not been repeated enough to create a problem with the survival of the waterlilies, but it does point out the unpredictability of wild animals. Our apes no longer have a distaste for water, a key element in the design of this facility.

A management procedure was begun in the third year which I believe has had a positive effect in reducing some of the stress of the animals on the plants. As part of the keeper's daily routine, seeds, nuts and branches of browse plants are scattered at random throughout the exhibit space which makes the animals move around in a natural foraging behavior. This also stimulates the animals for a portion of the day so they don't resort to total destruction of the plants as an escape from boredom.

By the end of summer we evaluated the successes and reviewed the failures in an effort to improve the appearance of the Monkey Island Exhibit. Three general areas require further experimentation with different plant species to achieve a well rounded appealing exhibit for the public. These are trees, shoreline and rockface plants.

Future

The trees in this exhibit are considered important to balance the structural aspect of the facility, to provide a perspective of ground, rocks and trees as a background to view the apes and to screen the view of the public on the other side of the exhibit. We have decided to leave six of the existing dead trunks in the exhibit to act as a jungle gym for the animals and replace the other dead trees with new species, such as Douglas Fir, spruce, cedar and possibly Araucaria. Perhaps the stiffer needles or pungent odor of some of these proposed trees will discourage complete destruction. Five of the new trees will be installed at the size of the original specifications 20-25 feet, but we also plan to transplant several young tree species and observe if there is any difference in the level of destruction. At one point we had considered hot wiring the trees, but the naturalness of having apes climb in real trees justifies the expense of tree replacement.

Replanting new aquatic plants and repositioning the containers within the underwater planter, away from the edge might permit new growth. Trying different species of bog and marsh plants may lead to a selection of plants which are uninteresting or unpalatable to the apes, or, if it so happens, we may end up planting all the containers with Pickeral Rush, this, so the shoreline will be at least vegetated. We also plan to repot some of the original aquatic plants and grow them off exhibit until established, then place them in the water moat. This will enable us to rule out the possibility that these plants didn't make it because of immaturity.

On the rockface area, we propose to increase the use of Phlox subulata of different horticultural varieties to add new colors in the spring and remain green during the rest of the season. We also anticipate experimenting with other vigorous shrubs and perennials to find what will survive in this setting. Plants, such as Summer Sweet, Viburnum, Elderberry, Strawberry, Achillia, Rudbeckia, Iberis, Daylilies and Asclepias have proven track records in other areas of the zoo and will be easy to transplant.

Summary

In relating our experience of design, implementation and management of the Monkey Island project I realize that a large number of variables have produced the results I have described. Extreme cold during the past three winters, possible faulty installation on the part of the landscape contractor, possible lack of proper maintenance by our own staff, unknown stress from heavily compacted subsoil, changing pH, artificial hot spots due to solar reflection and stress from secondary organisms are some of the reasons why the plants have failed in this exhibit, but, by in large, the animals are the major factor for plant failure in the exhibit.

I consider the exhibit a success to the degree that it reads as a naturalistic green background for barbary apes. The waterfalls, rocks, plants and other animals provide added interest for the viewing public. Theories have been reinforced and lessons have been learned to guide us into more intelligent planning for future exhibits and future experimentation should fine tune the exhibit landscape until a satisfactory balance is reached.

When it comes to the unique vocation of exhibiting live plants with wild zoo animals, I would like to paraphrase a quote from Jim Gibbons, Horticulturist, at the San Diego Wild Animal Park: "A zoo horticulturist will never be able to sit back and say he has succeeded, he can only strive to stay one step ahead of the animals."

MONKEY ISLAND EXHIBIT PLANT LIST

National Zoological Park

Original Planting (5/83)			Quantity
Loblolly Pine (Pinus taeda)			12
Japanese Black Pine (Pinus thunbergiana)			3
Red Twig Dogwood (Cornus alba 'Sibirica')			62
Memorial Rose (Rosa Wichuriana)			100
Flowering Raspberry (Rubus odoratus)			15
Moss Pink (Phlox subulata)			100
Mountain Sedum (Sedum ternatum)			100
Blueridge Blueberry (Vaccinium pallidum)			50
Arrow Arum (Peltandra virginica)			96
Water Canna (Thalia dealbata)			36
Giant Bulrush (Scirpus validus)			13
Pickerel Rush (Pontederia cordata)			102
Giant Arrowhead (Sagittaria montevidensis)			84
Narrow-leaved Cattail (Typha agustifolia)			198
Water Lily (Nymphaea)	'Virginalis'		2
	'Splendida'		2
	'Fabiola'		2
	'Charlene Strawn'		2
Grass mix:	Orchard Grass (Dactylis glomerata)	50%	
	Switchgrass (Panicum virgatum)	25%	
	Buffalograss (Buchloe dactyloides)	25%	

Plants Naturally Introduced (5/83 to 8/85)

- Thistle (Cirsium vulgare)
- Pokeweed (Phytolacca americana)
- Dandelion (Taraxacum officinale)
- Smartweed (Polygonum pensylvanicum)
- Silver Crabgrass (Eleusine indica)
- Dock (Rumex crispus)
- Speckled Alder (Alnus rugosa)
- Porcelain Berry (Ampelopsis brevipedunculata)

EXHIBIT PHILOSOPHY AND PROCESS

Charles Coburn
San Diego Zoo

What is the essence of a zoological garden? It is, without question, its living collection of plants and animals. Naturalistic zoo exhibits which simulate wild habitats are becoming the standard mode of presenting these collections to the public. The concept of immersion in themed exhibit areas is still relatively new to zoos. Past factionalism within zoos is gradually giving way, out of necessity, to a new sense of interdependency, communication, coordination, and cooperation. There is no alternative if we are to design, build, and maintain the complex environments we desire and our collections need. I would like to share with you a horticulturist's perspective on these developments.

I am sometimes asked if I would not prefer to deal with a purely botanical setting, away from the four-legged plant-eaters who complicate my work. My response is that zoos can become the botanic gardens of the future. In no other institutional setting do we have the opportunity to show the richness and diversity of living collections in their proper context. The exhibit value of both collections is strengthened by this association. If we do our job well there will be no more fascinating gardens than those of the zoos of the future.

Our plant collection in 1969 numbered 1,500 species. By the end of 1984 we counted 8,700 accessions of 5,000 different species, an increase of 233%. In 1969,13 plants new to the collection were accessed. In 1984 there were 1,500 accessions, an increase in the yearly rate of growth of 11,438%. These numbers indicate significant changes in the level of horticultural activity which has occurred during that period.

A new Southeast Asian outdoor exhibit area is being planned within our Tropical Rainforest bioclimatic zone. Though the Southern California coastal climate is mild and sustains many plant species, it clearly is not tropical. It was agreed that compromises would necessarily be made in our landscape, but that we would hold as an ideal as close a simulation of the natural forest environment as possible. Through analysis of actual forest systems, characteristic plant communities and other key features were abstracted and became three dimensional design images.

Images will become reality in two landscape phases. Phase One will yield an apparently finished landscape for the overall exhibit opening. Mature specimens for this phase will be moved from other locations on the zoo grounds, come from our current nursery inventory of appropriate Southeast Asian plants, or be purchased from commercial sources.

Phase Two will never be completed. It is the evolutionary and experimental movement of the landscape toward the natural forest. New tropical plants and propagules are being sought for this phase from wild populations and cultivated collections. As these plants gradually displace less desirable specimens the exhibit area will become an invaluable site for exotic plant enjoyment, observation, and research.

Among the plants we seek for this exhibit area are those which have the potential for use in our browse program. In the current program the horticulture department grows, harvests, and delivers daily, plant material from up to 36 species for use as a primary food source, food supplement, recreational device, or exhibit space enhancement.

As it exists this program is certainly beneficial to our animal collection, but we have really just begun to explore its range of possibilities. For example, of 500 species of acacia we presently use only two. These are fed to African animals primarily. If they have come from the wild, they did not sample either of these Australian trees until they arrived in the zoo. Of the 700 plus species of eugenia and closely related genera, we use two. These eugenia and acacia species were chosen for testing and feeding because they were already a part of the zoo landscape and therefore readily accessible in sufficient number to make regular harvesting convenient. The original source for these materials has since been supplemented by a browse farm and daily harvesting from surrounding communities.

Finally, feral diets are frequently more interesting, varied and healthful than captive provisions. The wild animal is allowed choices as it moves through its habitat range and experiences changes due to seasonal influence or other natural conditions. We cannot duplicate feral diets in every respect. We can make a substantial difference in the quality of our animals' lives through better determining their browse needs and then taking steps to meet them. The educational value of this approach has not yet been explored.

All zoos would benefit from an exchange of information concerning current browse practices. This information should be tempered by the observations of field researchers and existing literary references.

Naturalistic animal exhibits are usually challenging to manage and maintain. We can best meet that challenge by first clearly defining lines of responsibility and authority for the exhibit. We can then describe necessary maintenance procedures and program for their smooth interaction. Analysis of these procedures will yield labor cost estimates for each department involved. These figures, along with realistic estimates of recurrent maintenance costs, should become a part of the exhibit program and be the basis for long-term budgeting.

A horticultural history will be developed for each naturalistic exhibit. Starting with the architect's drawings, it will include a description of its animal population, browse provided, detailed information on the nature of the original landscape installation, and prescribed horticultural practices. Changes in the animal population, landscape features, and general observations concerning the exhibit will become a part of the history. As documentations of our exhibit experiences, these histories will be valuable resources for employee training and design reference.

If we are to communicate an honest, consistent, and powerfully motivational message to the public, principles of conservation must become operational determinants within our zoos. Efficient management of resources such as soil, water, energy, and labor will strengthen our conservation image in the minds of the public and, equally important, in the minds of our employees. Programs promoting animal conservation are relatively advanced, while internationally coordinated plant conservation strategies are just now being formulated. These strategies will be planned to match the natural conditions and available resources of participating botanic and zoological gardens. Thinking about the complexities of conservation issues can be truly mind-numbing, but it is our responsibility to seek to deal with them.

Our plant and animal collections must be built and managed with clear biological goals in mind. Random assortments of living things are not collections. The collections of our zoo are being reorganized into ten bioclimatic zones. Each plant or propagule now being accessed should be of value to us in our efforts to simulate the plant habitats of these zones. Though limiting, this approach gives focus and purpose to our collecting, nursery, and landscaping activities.

All zoos change. In order to give positive direction to that change we must determine and then strive to actualize worthwhile goals. Guest immersion in naturalistically integrated collections of plants and animals is desirable. A browse program based on a thorough understanding of animals' needs is beneficial to their health. Concerning ourselves with the intricacies of collection and exhibit management is necessary. Conservation of plants, animals, and other resources is our responsibility.

We are, in reality, one with the natural world. By serving other living things, we serve ourselves. In the words of one sage:

"We live that we may learn to love. We love that we may learn to live."

THE SMALL ZOO IN MASS SOCIETY

David Raboy

What follows is a brief synopsis of a longer discussion of potential development for small zoos during the next decade.

Mass society was a term coined in the early 60's by sociologists and others. It refers to the homogenization of American culture. Mass society arose through the impact of the TV media and its marketing of national values, norms, and ethics as portrayed by the major networks. Among the many results of this phenomenon has been the disappearance of regional cultural and linguistic diversity with the result that in general, cultural definitions become more and more universal throughout the country.

One of these definitions is a vague national standard defining "good and bad zoos", so that wherever you go in the country, certain zoos are always referred to as the best. Characteristically, one of these zoos provides the continued appearance of a popular media personality.

A more important element of this process is the acceptance of zoogeographic development as the formula for new development. Such titles as Wild Asia, the African Plains and Tropic World and similiar extravaganzas have entered our cultural mainstream. This is so much the case that many small zoos simply cannot compete, and yet they try.

A zoo Director in the northeast snow belt recently showed me a part of a new master plan which included a two acre African plains featuring three species of hoofstock, no predators and no provision for deep snow from November through April. No one should be surprised that the zoo in question is experiencing more than a little difficulty generating capital dollars for the master plan. Too often a grandiose idea simply cannot be reduced to the scale suggested above and be successful in the public mind. Yet some small zoos have thus far failed to explore alternatives.

Meaningful alternatives must meet certain criteria. First, they must provide exciting and sensitive exhibits which draw public interest and support. Second, and equally important, they must dramatize a serious education/conservation content. Third, they must be feasible within the geographic area of the zoo's location. If these criteria are met, the likelihood of capital funding is enhanced.

In the case of the Burnet Park Zoo in Syracuse, New York we were guided by these principles. Zoological exhibits were conceived and designed to portray and enhance the public understanding of several major educational themes drawn from the biological and ecological sciences. In each instance a particular theme was defined and then a sequences of exhibits was planned which would dramatize the theme in question. For example, an evolutionary theme was refined to include 14 exhibits in a sequence beginning 600 million years ago at a primitive tide pool. As the visitor moves along through a cave environment, 50 million year increments represented by exhibits suggest the evolution of increasingly complex life forms. Back lit graphics interpret the sequence so that a cumulative understanding of the evolution of complex life forms over millions of years is conveyed.

Will donors contribute to a controversial theme of this nature? We were able to attract one donor for $100,000 and several others for smaller amounts. The point is; the idea of sequencing exhibits coupled with thoughtful design worked.

In another sequence involving 12 exhibits, we chose the theme; animals who live in a complex social structure. Here each exhibit reflects a particular and unique aspect of complex social behavior. Actual exhibits wthin the complex, range from bees, ants, several forms of primate social structure, a lion pride, a waterfowl flock, as well as others. Again, interpretative graphics enhance the inherent educational value of this form of theme development.

In both of the previous examples, there is no effort whatever at zoogeographic integrity. The organizing theme is clearly something else entirely. Visitors who view the lions are not told the range and diet of these animals, rather they are told about the sisterhood, communal cub rearing and group hunting strategy. We assume zoo visitors know lions eat meat. The portrayal of the pride as a social structure provides many visitors with interesting new insights.

As an organized sequence of exhibits, animals as social beings has attracted approximately one-half million dollars in public support. We have found that political support and subsequent bonding of capital dollars is an easier proposition when public support can be translated into financial commitments.

The examples I have cited here are only a few of many that could be developed by small zoos and I would urge zoo professionals and zoo support groups to consider non-traditional, unique approaches to renovation and development of their respective facilities.

In the case of Burnet Park Zoo, the population base is less than 500,000 people and yet public and corporate support totaled two and one-half million dollars. On this basis, the Onondaga County Legislature committed and bonded the balance for our twelve million dollar project. I believe that our example can and should be duplicated elsewhere.

BUILDING A FOUNDATION

Karen A. Sausman
Executive Director
The Living Desert

Whether you are starting a new facility with a blank piece of paper and a bare patch of ground or whether you are undertaking the total renovation of an existing facility, the foundation that you build is of critical importance to the success of the project. No one in his right mind would start to build a house to live in by appropriating the first piece of bare ground and gathering up whatever materials are at hand and then starting to pound and hammer away without any thought or plan for the house--how many bedrooms, bathrooms?--or without the money available to finish it or even deciding whether this was the right location. Yet, at some level, many facilities have started, or continue to operate in this country, without a basic foundation, without the information that we all take for granted in the construction of something much less complicated like our own residences.

My comments today will center on four areas that I feel need to be addressed when building a "foundation" for a zoological facility. They are:

1) a clear mission statement;
2) a clear strategy for implementing the mission with goals and objectives;
3) a developed plan for community support;
4) a basic financial plan.

The first part of the "foundation" must be a clear, concise statement of the goals and purposes of the facility. For a zoological park it is not enough to say we want to build a collection of animals for public enjoyment and conservation. It's not specific enough, any more than saying "I want to build a house to live in." Embellish the mission statement with a series of goals and strategies designed to implement the goals. Be specific, be clear, and most of all be realistic about the capacity and potential of the organization.

A mission statement for a facility might be "to develop the world's largest collection of whales for the purpose of conservation and education of the public." But the realities of a statement like this, made by planners who are sitting in the middle of North Dakota in a community of 2,000 people, indicate that perhaps this isn't realistic. Unless, of course, one of those 2,000 people has an incredible interest in whales and unlimited resources to apply to the problem, in which case you don't need to be sitting in this room listening to me at all.

Having prepared the mission statement--then carefully and thoroughly prepare the plan for accomplishing your objectives. Prepare clearly-worded strategies for reaching your goals.

Once you have developed a mission statement and a series of goals with strategies for reaching them, set them down in a professional-appearing booklet that will be available to use for generating the next two bases of your "foundation", community support and financing.

Again, unless you are the man from North Dakota who can build his own private facility with no need of outside support, whether you are a municipal, county or state facility, or a private organization, the growth of your organization will depend a great deal upon the support you derive from the community you serve. If you are located in a major population center you may not need to reach much further than the area directly around you. But, if you are thinking of starting a facility that is going to be more regional, or statewide in scope, then the whole region/state becomes your "community".

It is imperative that you begin to share with the community your mission statement and the strategies for achieving your facility's goals. Talk to everyone and anyone. Begin to search for a board, if you are a non-profit organization, of individuals who can help implement your programs. Educate the people in your governing body about your goals and purposes.

During this period of time begin immediately to demonstrate professionalism. Be where you say you are going to be, do what you say you are going to do, deliver what you promise. It won't take long for the people in your community, whether it is a small area or a large city, to recognize that you and your organization are professionals, planning to do a professional job.

Keep your community informed, through the press, through newsletters or even news bulletins sent out to individuals and organizations that should be interested in what you are doing. It doesn't take a lot of funds to be professional--to deliver what you promise, as long as you are realistic in what you promise to deliver. It sounds like common sense, but I assure you I've seen some very unsensible behavior! Planners going in front of city councils without the data in hand to explain or justify facilities, individuals who are supposed to speak before a large service organization forgetting to appear.

Finally, part of the professionalism in building your "foundation" is in creating clear budgets, based on each year's development to demonstrate financial responsibility. In order to operate and grow, non-profit facilities must depend upon the generosity of individuals, corporations and foundations, or upon funding from a governmental agency. Your demonstration of financial responsibility is yet one more layer of professionalism necessary for the continued development of your facility.

Keep accurate records of income and expenditures. Have them audited annually to be certain that you are keeping your accounts appropriately. Create a budget and stick to it. I am frequently amazed by organizations that feel they can solicit funds for one purpose and then, because of some pressure, decide to use them for another purpose. This is the quickest way I can think of to prove to your supporters that you are not worthy of their support. No matter how beneficial your causes may be, foundations and corporations are less and less likely to come to your aid with "bail-out" money if financial mismanagement has caused your problem. The ends hardly ever justify the means, especially in today's economic climate. More and more corporations, foundations, and private donors are carefully reviewing organizations' records for financial responsibility.

Keep financial records from the first day that your facility becomes more than a dream, with the first gift and the first expenditure. Keep an accurate record of every dollar that comes in or goes out--where it came from and where it went. "Of course", you say? I could give you a list of institutions, too long to rattle off here, who have not done this until very recently and some that are still not doing it adequately. I can draw on one story from my own facility to illustrate the dividends of record keeping. We started The Living Desert fifteen years ago at which time our membership began. One of these members was a gentleman who took out a modest membership. He continued to do so every year, for fifteen years, and also, from time to time, he would make a slightly larger donation for a special project, never more than $100 or $200. Last year he stopped by the office and asked if I would have a time to see him. Before he came in I asked our membership secretary to give me his total giving record over the last 15 years and had a copy of it out in front of me. When he visited he noticed the piece of paper and was astounded that I had a list of every gift he had given us, including his membership dues for 15 years, including the date, and what the gift was for. I told him I had this information for every member, indeed for every individual and organization, foundation and corporation, that had ever given The Living Desert a gift. He reported that he would like to make The Living Desert another gift and would like to go home and think about it. I thanked him for the visit. Two weeks later a check came for $5,000 with a note that he knew it would be well spent, and over the years other donations followed.

It is never too early to start keeping records. It is never too early to start proving financial responsibility in all of your dealings. Keep records, pay your bills.

Thus, building a foundation for a facility--whether large or small--is not a difficult process. It is more one of common sense and follow-through.

Develop a mission statement.

Develop a strategic plan.

Develop community support.

Develop professional financial management practices.

NO STAFF, NO TIME, NO MONEY!

L. Patricia Simmons, Executive Director, Akron Zoological Park

Small non-profit organizations have many unique characteristics not common to their larger, more affluent collegue institutions. For instance, small zoos tend to:

1. Have a more personal management often centering around one figure.
2. They are newer, less well established.
3. They have difficulty in achieveing financial growth and maintaining yearly operations.
4. They find it difficult to create a distinct image or marketing niche, possibly because no one knows your there.

However, the average consumer is not likely to see these stylistic differences between the small and large zoo. More than likely they question why your zoo does not live up to the capabilities of the larger zoo.

Before you leap on you customers critism and cry "No staff! No time! No money!" stop a minute. What is it we really want? If it is that we wish them to view us as an entity unique, professional and worthy of our current size, then we must tell them what we want them to know. In addition, we must show them what we wish them to know. In essence, we must communicate, in every way, to acquire the desired image.

Image is to be reckoned with. The way our institutions are perceived has much to do with the number of tickets we sell and to whom, and how many contributions we receive and from whom. Image leads to our survival and growth or to our failure.

By the 1980's, the Akron Zoo, a once successful children's zoo, was struggling for survival. Neighborhood racial riots, murders and animal bludgeonings had lead to a desperately poor public image and the ensuing financial consequences. Our community would not forget.

At this point, the Akron Zoological Park Board of Trustees took some dramatic steps toward the survival of the zoo. One of the most important steps was to become a "new world zoo" specializing in animals from North, Central and South America.

This decision, along with the name change from the Akron Children's Zoo to the Akron Zoological Park, had one major effect. It made us unique. Ohio is rich with fine total-world zoos. How can a struggling zoo, so much smaller, shine in their shadows? We accomplished a basic. The Board of Trustees took a major step toward knowing who they are and what they want to be.

Our next job was and continues to be the management function. Communication. Image for the zoo must be carefully and sensitively obtained through a continued and planned approach of communication. You must develop your institutions undergirdings. This means you sweat the details.

You must identify and address misunderstandings everyday. Be the best you can be. Provide excellent animal care, keep all the litter cleaned, repair, paint and demand achievement. Return every telephone call, answer every letter; be beyond reproach as an institution. Make sure the signs are straight and every donor is listed, with their name spelled correctly. And, get the newsletter out on time.

Then, as all of this comes together, we can present ourselves with pride and convincingly announce "We are one heck of a good institution and this city, its constituency and its corporations can be proud to have us!"

This is where funding begins. With image.

The Akron Zoo is at its infant stages of seeking funds. However, we can boast of increased support from the city, its corporations, foundations, individuals and news media. In addition, this year we applied for and received our first Institute of Museum Services Operations Grant at our maximum support level.

When you know what you must have and actively, tirelessly, and sensitively pursue it, you shall succeed. You shall gain respect. But, more importantly, your zoo shall obtain the unique and professional image you seek.

RESEARCH IN A SMALL ZOO

Susan M. Engfer
Assistant Director
Santa Barbara Zoo

Five years ago, the Santa Barbara Zoo did not conduct research of any kind. Justification for this was based on the fact that Santa Barbara was a small zoo with very limited resources, and at the time, few small zoos were actively supporting research efforts. Today, Santa Barbara and other small zoos are discovering the capability to conduct scientific studies of merit in spite of financial and staffing limitations.

Presently, the Santa Barbara Zoo supports a rather extensive research effort for a zoo of its size. Our research department is staffed by a full time research cuartor, a full time veterinarian and a corps of volunteers made up of university students, professionals and interested lay people.

Studies presently in progress include: reproductive behavior and physiology in the Asian small-clawed otter (Aonyx cinerea) and the giant anteater (Myremecophaga tridactyla); artificial insemination of the Asian elephant (Elephas maximus); visual acuity and concept formation of the Asian elephant; comparative behavioral profiles of the lesser spot-nosed guenon (Cercopithecus petaurista) in a non-enriched and enriched environment.

The first real committment to a research project was precipitated by our elephant keepers four years ago. Out of a deep concern for the diminishing numbers of Asian elephants in nature and the limited number of breeding facilities in zoos, the keepers felt that it was essential that Santa Barbara be involved in a long-range propagation project with the Asian elephant. Because of limited housing space, staff and funds, it was evident that the zoo could not properly house a bull. With encouragement from the zoo management, the keepers pursued other avenues and developed a collaborative arrangement with Dr. Mike Schmidt and the Washington Park Zoo in Portland to work on artificial insemination. Through the creative efforts, patience and hard work of the keepers, nearly four years of estus cycles have been charted, and our two cows are trained to accept the AI procedure. Publicity of the keepers' work resulted in a local foundation donating $10,000 to support this project.

The development of the zoo's full-fledged research effort, starting with this project, progressed quite rapidly. The realization that conducting scientific studies was an essential component of fulfilling the goals of conservation and education led to two significant decisions that resulted in the establishment of the zoo's research program. The first involved creating a position for a full time staff veterinarian to provide not only the highest quality health care for the collection, but also to assist the zoo with education, conservation and research activities. Dr. Donald Gillespie was hired in April 1984 and has brought to the zoo expertise and extensive research experience in reproductive physiology.

The second decision involved granting permission to a temporarily unaffiliated experimental psychologist to conduct a research project with our Asian elephants. Dr. Cynthia Bennett had been conducting studies for many years on behavior, aging, cognition, sensation and perception in primates while affiliated with Washington State University and the University of Texas. Dr. Bennett proposed studying visual acuity and concept formation in our elephants.

This proposal brought up an important question that must be addressed by any zoo interested in developing collaborative programs, particularly with researchers from the academic community: if an immediate application of the research results can not be identified, is the project of value to the zoo and the management and/or conservation of the species involved? In a recent article, Dr. Devra Kleiman, while emphasizing that research projects must be of scientific merit, states, "Zoological parks must support basic research as part of their overall mission, even if there is no obvious current application of the results to the conservation or educational objectives of the institution." Surely, a reluctance to authorize "good" research on the sole basis of lack of immediate applicability is short-sighted.

It was this conviction that led us to accept Dr. Bennett's proposal two years ago based on the quality of research design, the validity of the scientific questions being addressed, the lack of systematically acquired information in this area and, perhaps most importantly, the sensitivity of Dr. Bennett to the on-going operations of the zoo. Her project was designed to cost the zoo an absolute minimum of funds and manpower and to not interfere with the public exhibition of these highly popular animals.

Within a year, Dr. Bennett had become a full time volunteer research curator at the zoo. She, Dr. Gillespie and researchers from other institutions were collaborating on several reproduction studies. University student interns were collecting behavioral data on several species. Dr. Gillespie had encouraged a number of outside professionals in a variety of fields to volunteer their time and expertise with several projects.

Santa Barbara has pursued a variety of avenues to support research efforts. First, the zoo's operating budget was increased to accommodate a full time staff veterinarian. All departments in the zoo tightened their belts, and new, creative ways to increase general income to support the position on a permanent basis were pursued including reorganization and expansion of the food service operation; expansion of the gift shop operation; the addition of elephant rides. Because of the multiple advantages to the zoo and the collection, the creation of this position was completely supported by our governing authority and has worked out very well.

Second, grants are being sought from private, corporate and government institutions to fund research projects at the zoo. Two projects have been funded to date. In addition, the research curator position is now funded for the 1985-86 fiscal year through an IMS General Operations Support Grant.

Third, the staff has developed a network of affiliations with private and professional people and organizations both locally and throughout the country that can be called upon for their expertise and for assistance through loans or donations of equipment, supplies, services. Volunteers contribute hundreds of hours to research through formal university programs and zoo educational programs.

Obviously, there are many problems that must be overcome in establishing research as a priority activity in any size zoo; not the least of these is funding. Several authors (King 1984, Kleinman 1985, Swift 1985) have pointed out that excellent programs can be conducted on very limited budgets by collaborating with other local institutions, such as colleges and universities, in low cost ethology or animal behavior studies. However, all acknowledge that coordination by a zoo person is normally required to manage a successful program, even at this level.

One of the major problems for small zoos is finding someone within the organization who is willing and able to take on the extra duty of organizing and coordinating a research program. Often, the already overworked staff of a small zoo simply will not be able to assume this added responsibility. Santa Barbara was very fortunate to have a highly qualified volunteer willing to fill the position which we were later able to fund. If a staff member or qualified volunteer is not available, hiring a part time research coordinator has proven effective (Swift 1985). If this is prohibitive, another possibility for assistance may be developing.

Within the past few months, a new and exciting program has been developing in Southern California. Through the extraordinary committment, energy and organizational abilities of

Dr. Donna Hardy of California State University, Northridge, a Consortium of Aquariums, Universities and Zoos (CAUZ) is being formed to aid in the development of symbiotic relationships between institutions, in all disciplins, by acting as a clearing house for information; a resource for access to equipment, libraries, services generally not available to zoos and aquariums; and a coordination center for "hooking" up mutual interests and overseeing multi-instituional collaborative programs. One of the major thrusts of the consortium will be to promote research in small zoos by providing training through a standardized model project and support through a research "hot line" and the identification of potential funding sources. Partially as a result of the consortium, Santa Barbara's Research Curator is assisting another small zoo that has not conducted research previously and did not know where to begin, in designing a behavioral study with a species in their collection.

In conclusion, there are possibly as many ways to develop and maintain quality research programs in small zoos as there are individual small zoos. Santa Barbara has found its own unique way. Small zoos are making significant contributions to education and conservation programs. A number are supporting very good research efforts. It is encumbant upon all institutions to evaluate how they may contribute to the accumulation of the body of knowledge that will ultimately be essential to fulfilling our primary collective goals of conservation and preservation of animal species in captivity and in nature.

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THE CONSERVATION AND RESEARCH COMMITMENT
NOT A FACTOR OF ZOO SIZE

Charles Wikenhauser, Director, John Ball Zoo
Brenda Stringer, Director Publicity & Public Relations
John Ball Zoological Society

A commitment to conservation and zoological research is the responsibility of every zoo, aquarium, and their respective support organizations. Too many times this becomes only a passive commitment in the form of graphics or a small part in their educational program. Zoos and the people that support them must contribute time, money and space. Size need not have anything to do with a commitment to excellence in any aspect or purpose of your zoo. A small zoo can contribute to the international effort in conservation in as meaningful a way as a large zoo. "There are no small parts, only small actors." None of us need ever think of ourselves as second rate simply because we do not have a budget in seven figures.

One of the most valuable resources for any micro-zoo is its community. A micro-zoo can have a more intimate relationship with its neighbors and usually must rely heavily on their goodwill and support. We have experienced a rebirth at our Zoo because of the generosity and enthusiasm of the private community. In the past four years individuals and businesses have privately donated $3.5 million dollars and have built eight new exhibits.

Perhaps the most dramatic and visible support has come from our business community through promotions. The media attention, increase in attendance, (130,000 or 62% in the same four years), and additional funding generated by the promotions has been very beneficial to our Zoo. Many worthwhile relationships in the business community have come from these endeavors.

A project which developed out of one of these relationships is the Mr. Fables Wildlife Conservation Fund. You might wonder how onion rings and cheeseburgers could really contribute to conservation, but in Grand Rapids they do. Mr. Fables is a locally owned fast-food, family restaurant chain. We had done several promotions with them in the past and they had contributed funding for various projects. The Mr. Fables owners did not like to donate to large capital drives, but preferred projects that they could totally fund. One previous promotion had contributed $20,000 for the purchase of animals for our new nocturnal exhibits.

Mr. Fables' promotions are handled through a local marketing firm. An account executive from the firm had developed a real interest in the Zoo and was always interested in projects in which Mr. Fables could become more involved. Last December, the marketing agency account executive contacted us and asked for a list of promotions, events, projects, etc., for the coming year.

The staff of the Zoo had long wanted a conservation fund. Limited by funding, size of staff, etc., we felt one of the most effective ways we could contribute was by offering our facilities and private funding for conservation projects. Our concern was finding seed money that would not take away from the John Ball Zoo Society's ongoing capital campaign. While preparing a list of '85 projects for the marketing firm, things "clicked" in our mind. Mr. Fables might be the perfect prospect for the conservation fund.

An initial proposal was presented to the marketing agency at an informal meeting. Their representative was very receptive and immediately came up with promotional ideas and ways of generating income. As a "family" restaurant and community leaders the agency felt that Mr. Fables owners would be responsive as well.

The agency prepared a formal proposal outlining promotions, public relations aspects, types of projects, etc. and presented it to the owners. Mr. Fables people were very interested and a meeting was set with Zoo Staff. We presented the more idealistic side of the conservation fund and the reasons why such a fund were so important to the Zoo.

Mr. Fables agreed to sponsor the fund and to pledge $50,000. Store promotions would provide a minimum of $30,000 and the corporation would make a cash contribution of $20,000. All parties assume that Mr. Fables will continue to support the fund beyond their pledge period.

The John Ball Zoological Society undertook the responsibility for setting up the fund and will administer investments and accounting. Zoo Staff, working with a legal firm that represents Mr. Fables worked up a document that stated the formal purpose of the conservation fund and the mechanics for its operation.

Purposes and Operational Guidelines of Mr. Fables Wildlife Conservation Fund

The purpose of the account known as the Mr. Fables Wildlife Conservation Fund is to make a positive contribution toward the preservation of endangered species through research; collecting, breeding, and reintroduction of rare animals into their natural habitat; support of work by other organizations with similar purposes; sponsorship of symposia, seminars, and workshops; publication of studies and significant research; sponsorship of positions at the John Ball Zoo and at nearby institutions of higher education; and other activities that support or enhance the above purposes.

The fund will operate as follows:

1. Fund Committee. The Fund Committee will be responsible for the development of funding sources and the general management of the Fund including the investment of Fund assets, and the publication of an annual report of the

Fund. The Fund Committee will also enter into promotional contracts, on behalf of the Fund, for financial support of the Fund and for the expenditure of monies as recommended by the Allocation Committee. The Fund Committee consists of three members: John Ball Zoo Director, John Ball Zoological Society Treasurer, an individual associated with Mr. Fables Systems, Inc.

2. Allocation Committee. The Allocation Committee will establish guidelines for applicants who seek funding, review all proposed projects, and, after consulting with the Fund Committee, allocate available funds to projects to be sponsored or supported by the Fund. The Allocation Committee consists of four members: biology professor, museum administrator, Michigan Department of Natural Resources representative, Doctor of Veterinary medicine.

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When everyone was ready to go, a press conference was held to announce the fund. AAZPA Executive Director Robert Wagner attended the press conference to help add some national significance to our endeavor and to comment on the AAZPA's own conservation efforts. Media attendance was excellent and the coverage was wonderful. Interest has been high and we expect contributions to the fund from a variety of additional private sources. The conservation fund is now in place and we hope to award the first grants in late Fall.

A zoo's moral commitment to wildlife conservation can be very sincere. Its size and available resources should never limit that zoo's contribution to the conservation effort. Yes, the fund is still small, but our feeling is that even if it can help a little - it will help a lot!

SMALL ZOO, BIG CITY
HOW A SMALL ZOO GETS MAXIMUM PUBLICITY IN THE SHADOW OF GIANTS

By Kathryn G. Whitford
CEO of K.Grant Whitford, Inc.
Staten Island, New York

Publicity for the small zoo is like food or medication for the average person, essential for good health in the correct proportions and harmful if abused.

The Staten Island Zoo is a perfect example. Despite its minimum size, eight and a half acres, it has in recent years garnered worldwide publicity without losing control.

There are really two levels to a program of maximum exposure for a small facility in a major city. The first is to create newsworthy material for a very sophisticated press. The second is to keep control once the publicity has been achieved.

Before we try to explain either level, a glimpse of the Staten Island Zoo and its history would be helpful.

It was during the dark days of the Depression that an eight-acre tract of highly cultivated land on Staten Island's North Shore was willed to New York City with the stipulation that a memorial park be created. The proposed conversion of the existing mansion into a natural history museum and the construction of a zoological building to house live exhibits was a welcome project to a Depression-torn economy.

For a three year period, planning, negotiating, financing and building proceeded in spurts, culminating in a marathon three-week drive in which more than 1,000 WPA men worked from 8 a.m. to midnight to complete the $150,000 project. On June 10, 1936, America's first educational zoo was dedicated to the cheers of 5,000 Staten Islanders.

For almost half a century very little changed at the charming Staten Island zoological park. Philosophically, the founding fathers had been well ahead of their contemporaries in emphasizing education. Physically, the site maintained its park-like setting, a verdant oasis within the boundaries of a concrete giant. Promotionally, the zoo was presented as New York's Biggest Little Zoo, never competing with the numerous larger facilities within the city's limits.

But age claims all and by the beginning of the 1980s, while the mental prowess of its leaders remained sharp and clear, the years were making their marks physically. In keeping with our

Fund. The Fund Committee will also enter into promotional contracts, on behalf of the Fund, for financial support of the Fund and for the expenditure of monies as recommended by the Allocation Committee. The Fund Committee consists of three members: John Ball Zoo Director, John Ball Zoological Society Treasurer, an individual associated with Mr. Fables Systems, Inc.

2. *Allocation Committee*. The Allocation Committee will establish guidelines for applicants who seek funding, review all proposed projects, and, after consulting with the Fund Committee, allocate available funds to projects to be sponsored or supported by the Fund. The Allocation Committee consists of four members: biology professor, museum administrator, Michigan Department of Natural Resources representative, Doctor of Veterinary medicine.

3. *Endowment*. The net income of the Fund, and all principle assets which constitute the Fund, may be used for the designated purposes of the Fund. The Allocation Committee, after consulting with the Fund Committee, will determine the total amount of the Fund available for disbursement.

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But age claims all and by the beginning of the 1980s, while the mental prowess of its leaders remained sharp and clear, the years were making their marks physically. In keeping with our

initial human analogy we note that instead of its eyesight fading, it was the heating and ventilation system; instead of wrinkles in the face, it was cracks in the concrete walks; instead of an outdated hairdo, it was large birds and cats in small cages. As the Staten Island Zoo approached its golden anniversary, it became apparent that some modernization and renovations were in order. That all came in the person of a dynamic new director who in the last four years has guided development of a long-range plan, sought and achieved millions of dollars in public monies and initiated major renovation and new construction projects. In addition, his public relations sense was acute and, fortunately for his public relations consultant, he allowed unprecedented freedom in creative planning.

The public relations objectives were to obtain optimal publicity for the zoo to support its development program and to increase on-going attendance within the parameters of its size. (What must be kept in mind throughout the period is that we are dealing with a 1936 facility designed and constructed to serve a borough whose population more than tripled during the past decade. Not only do we have minimum acreage, but also less than adequate sanitary and eating facilities as well as no access for the handicapped. Complicating the situation is that major construction is in process.)

The promotion plan was two-fold. First to increase local coverage of the zoo's programs. Again, the public relations job was made easier by the fact that the zoo had excellent education and graphics departments with imaginative directors. Events such as the spring Egg-stravaganza and the summer Zoo Olympics needed only the standard professional distribution for good coverage and a marked increase in attendance.

Second, and the area where the zoo has achieved remarkable success, was special events. Openings of minor exhibits became award-winners, and by seeking press coverage of the event rather than announcements prior to the event, the resulting publicity created a spread out, steady flow of visitors rather than an uncontrollable surge for the event. In fact, the timing of some of the events was considered to minimize crowds. Maximum publicity, minimum crowds was our strategy, thus did publicity work for the zoo's special needs.

Let me give you some examples of exhibit openings and "non-events" which won major public relations recognition, including metropolitan and international awards:

AN OTTER OPENING OF AN OTTER SHOW -- Background: The zoo's population included three Canadian river otters temporarily housed in an outdoor bird cage with a small make-shift pool. The animals were reclusive and the public saw little of them as they slept most of the day in a box-like area. The new exhibit was being constructed by the zoo's own maintenance department in the former alligator pool. A $25,000 exhibit underwritten by the Staten Island Zoological Society, New York State, Chase Manhattan Bank, and private donations. (Make note of the contributors.)

Event: Using the zoo's Broadway address, we began to create a show event, to be held on a Wednesday afternoon, standard matinee time. Invitations became replicas of theatre tickets, hostesses became usherettes complete with black dress and flashlights, the program became a Playbill duplicating the familiar features. Show tunes were piped over the P.A. system. A VIP reception was arranged for at a local restaurant known before the day as the Other Place, renamed the Otter Place.

Results: The opening of a small zoo's, low-budget exhibit became a front-page story in the local press and reported in publications such as the New York Times, New York Daily News and New York Post. Radio and television responded -- and Staten Island's "local" stations are CBS, NBC and the like. The little Staten Island Zoo had made a dent in the big media world and the event won awards from the Community Agency Public Relations Association of New York (CAPRA) and the International Casebook Award. Chase Manhattan Bank approached the zoo's director offering a contribution of $10,000 to be the sole sponsor of another, similar exhibit. Attendance at the zoo was steadily increasing and, by the end of the first year of professional public relations programming, more than doubled.

The biggest concern -- what do you do to top this?

With a $10,000 offer, you think fast.

THE ZOO STEEPLECHASE -- Background: The next project which the director wanted to undertake in that price range was the replacement of the existing pony facilities, which were in very poor condition and had been cited by the New York City Health Department. A one-story, Kentucky blue-grass style stable was constructed and landscaped.

Event: The event was scheduled for the Monday morning after the Kentucky Derby. The theme was thoroughbred. We were off and running. A new pony purchased by the zoo was ceremoniously named Chase, after our benefactor. (The Bronx Zoo had recently named a newly born elephant Astor after a $2,000,000 contributor. We felt we were doing our best --- and the newspapers loved the comparison.) The program was a take-off on a scratch sheet and the highlight of the event was a simulated horserace amongst the zoo's ponies. Ironically, Chase won and the bank's vice president had the honor of placing the traditional floral horseshoe around the winner's neck. A luncheon at a local restaurant was preceded by mint julips.

Results: The Zoo SteepleCHASE won another CAPRA award. Attendance continued to increase and Chase Manhattan Bank wanted to know what we do next.

BRINGING HOME JALOPY -- Background: Who could resist the story of a valiant middle-aged Galapagos tortoise who conquered cancer? Jalopy was the zoo's first resident when it opened in 1936, loved by two generations of zoo goers. During the preceding several years he had undergone surgery for a recurring benign tumor between his neck and left leg. The zoo's veterinarian devised an ingenious, skateboard style device to allow Jalopy movement when the patient showed signs of decline by being immobilized. A new procedure indicated a malignancy, and with no veterinarian literature addressing reptilian carcinoma treatment, it appeared for awhile that euthanasia was inevitable. When it was learned that a veterinarian oncologist at the University of Arizona was working in that very area, zoo officials opted for another chance for the otherwise healthy tortoise with at least another 70-year life expectancy. Though the prognosis was discouraging, it allowed a measure of hope and Jalopy took a quiet late spring flight to Arizona where he was received as an honored guest. His response was remarkable and by summer's end word came that his cancerous tissues had been dissolved by radiation therapy. Jalopy was coming home, and we were going to bring him home in style!

Event: Nothing less than a hero's welcome was considered. The Staten Island borough president agreed to a brass band reception at Borough Hall Plaza complete with proclamation of Jalopy Day on Staten Island. This time we wanted people, lots of people, thus we chose the day immediately after the Labor Day holiday, one of the slowest news days of the year. The American Antique Car Association agreed to provide vintage cars for a car-a-van from Borough Hall to the zoo. Jalopy rode in a, believe-it-or-not, 1936 vegetable truck discovered to be owned by a local restaurateur, its open back providing good visibility for those along the route. At the zoo, tickertape, provided by the Trans Lux Corporation, which had also provided the tickertape to welcome home the Iranian hostages, awaited the long parade led by Jalopy. A giant reception for all was provided by Chase Manhattan Bank, which also paid Jalopy's travel expenses.

Results: A media coup which won the International Association of Business Communicators' first-place media relations award as well as another CAPRA award was only one reward. The zoo was inundated with letters, cards, telegrams and messages as a result of live coverage by every television network as well as all but one of New York's television stations, both major news syndicates, 20 metropolitan area radio stations, all Staten Island media, and requests for stories by publications and broadcast media from Europe, Canada and Australia.

THE JALOPY MEMORIAL DEDICATION -- Background: Jalopy's drastic decline and sudden death just four months after his jubilant homecoming was an emotional shock to everyone. Now newspapers, television and radio stations called the zoo. All of New York was responding to a death at a zoo which two years ago it didn't know it housed. Jalopy's death was so traumatic that for several months a memorial could not even be discussed and when it was, everyone had a strong opinion on what it should be. A brass statue was the favorite until a trustee suggested a topiary, a living bush sculpted in the form of a beloved friend.

Event: Because Jalopy was so very special to so many people, his memorial dedication could not be run-of-the-mill. It wasn't. The wife of the vice president of the United States came to Staten Island to unveil the topiary and pay tribute to the important role he played in life, both as a lovable animal and a medical pioneer publicly hailed by the American Cancer Society for what future application to the human cancer therapy his treatment might play. Mrs. George Bush was invited to lead the ceremony for several reasons. Obviously the play on the name Bush with the topiary was the primary. She also had recently published a book on the subject of the family dog, indicating she is an animal-lover, and she and the vice president had lost a child to cancer. And, what a wonderful guest she turned out to be. The day was a glorious summer gift tucked amongst a month of rainy days. The ceremony was appropriately serious, laced with nostalgic reminisences by local public officials and the inevitable jocularity of the New York City Commissioner of Parks and Recreation. At a reception on the zoo's Great Lawn following, Mrs. Bush shook hands, signed copies of her book, chatted with guests and posed for photos, a gracious hostess as well as honored guest.

Results: Again the zoo gathered in nation-wide print and broadcast coverage.

While the Staten Island Zoo will never be competition to its fellow New York City zoos, it has found its own niche by emphasizing what others might consider a handicap, its small size. Its long-range plan calls for renovated and new exhibits of smaller animals in more natural environments. Its general information flyer is titled "New York's Biggest Little Zoo." It has substituted creativity for bigness and enjoyed unparalleled success. It applies the David principle to promotion -- a big idea can come from a little feller and that people, who comprise every press corps, like novel ideas to which they can apply their own creative instincts for a different story. And, most important, by planning, it has its publicity work for its objectives rather than having to work to correct the results of runaway publicity.

"STEAK" PROMOTIONS ON A "BOLOGNA" BUDGET

SUSAN C. HARRIS
MARKETING COORDINATOR
BINDER PARK ZOO
BATTLE CREEK, MI

The Binder Park Zoo is a small zoo with big ideas. There is no money budgeted for promotions or advertising, but that doesn't stop us from having excellent special events and spreading the word about the zoo.

The following "meaty" promotions have cost us little, if anything, except some planning and execution time. They have all been extremely successful, resulting in increased zoo attendance and public awareness. It would take days to discuss details, so we will just provide a brief description of each event. We would be happy to provide more detailed information upon request.

HUDSON'S EAGLE AVIARY - Two years ago, in celebration of the opening of Hudson's (a large, first-class department store), 10,000 balloons were filled with helium and released into the air. The balloons carried tags sold by the zoo to fund the building of an eagle aviary. (Donations were later matched by a grant from Hudson's, providing $20,000 for aviary construction.) When the balloons landed, people returned the tags to Hudson's where their names were placed in a drawing for gift certificates and zoo memberships.

The promotion continued each year with anniversary celebrations at the zoo, climaxing this August with the grand opening of the eagle aviary.

Local residents are still talking about the balloon lift-off, and they have enjoyed the entertainment at the zoo on "Hudson's Children's Day" (everything paid for by Hudson's).

BIG DAY - What began as an annual 10K race, "Run for the Animals", in May has been expanded into a "Big Day", complete with family activities centered around health, fitness, and FUN!

The local Road Runners organization does most of the race work. Zoo staff takes care of the other activities (entertainment, booths, zoo-lympics) and all publicity. All funding is through race registrations and business sponsorships from a cereal company, local bank, health maintenance organization, and local hospital.

This is our biggest attendance day. The event will be expanded in the future, possibly adding another day to include a walk-a-thon or bike-a-thon.

HOOFIN' FOR HEALTH - An outdoor walking program for adults at the zoo. We provide the walking area; a local hospital provides nursing staff to lead "Zoorobics" and check blood pressure and pulse rates. Unique community service project.

BILL KNAPP'S BIRTHDAY PARTIES - Family food chain provides birthday package that includes lunch at their restaurant and admission passes to the zoo. Promotion kick-off included a birthday party for zoo Aldabra tortoise, with free cake and balloons for visitors furnished by Knapp's.

McDONALD'S - Most McDonald's are looking for ways to get involved in community projects. One local promotion even included McDonald's employees - they held a car wash and dog wash to raise money to help purchase llamas for the zoo.

Our most recent effort was a "Community Day" at the zoo featuring magic shows by Ronald McDonald. Free admission day (McDonald's paid us one lump sum to cover operating expenses and admission receipts) brought in many visitors that had not visited the zoo before.

A neighboring city, Kalamazoo, does not have a zoo of its own. We ran a summer-long promotion with their 12 restaurants called "Bringing the Zoo to Kalamazoo". We provided two-hour Zoomobile visits in exchange for placements, bag stuffers, and extensive publicity.

C-Stores - Local C-Stores (convenience food stores in gas stations) are purchasing two white-handed gibbons for the zoo by running summer promotions with Coca Cola. The slogan goes - "We're 'gibbon' 25¢ to the Binder Park Zoo for every six-pack of Coke purchased during July...". Coke gives money to some large volume customers to run promotions such as this one.

COLORING BOOKS - Our newly-opened shopping mall has several small fast food operations in it. They prepared and printed a coloring book featuring our zoo animals. In June, children received an animal sticker with each food purchase to put in their books. When each page (nine total) had a sticker on it, the book could then be taken to the zoo and the child was admitted free. About 2,500 coloring books were distributed, but very few brought back to us. This would have been more successful if more time had been allowed to collect the stickers. But a good idea!

A Zoomobile Project...in the Beginning

Michael Skinner
Curator of Education
Central Texas Zoo
Waco, Texas

The Central Texas Zoo's education program has shown a significant increase in the number of people receiving services since the zoomobile program began in the spring of 1985.

The central Texas region is unique because there is little outlet for the dissemination of environmental education information. The two institutions which offer this kind of information are the Central Texas Zoo and Baylor University. Even though the zoo offers a wide array of environmental education programming in-house, it has become more difficult for Texas public school children to take advantage of these programs. This is due to the new mandates set forth in the Texas legislature that keeps students in the classroom and allows less time for field trips. As of July,1985 however, restrictions on grades K-5 have lessened somewhat. This means that elementary students can take field trips whcih last for more than one hour. There is a stipulation that teachers must account for the time that the students are in-transit. This means that there must some activity (subject related), for the students going to and coming from the field trip site.

Initially the goal of the zoomobile project was two-fold. 1.) to facilitate environmental education in the central Texas region and, 2.) to increase the public's awareness of what a zoological institution is and what it has to offer. There was later a third goal enlisted to help facilitate working with the state mandates on education. That was to offer as much of our in-house programming on an out-reach basis to school groups that were unable to travel to the zoo because of the state mandates.

With these goals as a foundation research was started to satisfy the City of Waco's expectations and also the possible grantor.

The City of Waco requested information concerning cost of such a vehicle, operating expenses, insurance, user groups, etc.

It was the intention of this project to make the zoomobile a multiple-use vehicle, e.g. to offer as many different kinds of programs as possible, i.e. school groups, nursing home visits, hospital pediatric wards, weekend wildlife outings, wilderness backpacking trips, etc.

School groups, both public and private, receive programming free of charge if they are within Waco city limits and/or inside McLennan County. School groups outside of these areas are a flat rate fee of $50 plus mileage. Other groups are charged according to distance, number of participants, and type of program.

There are two levels of programming provided by the zoomobile for school groups. The elementary schools, which do not have the field trip restrictions as do the secondary schools, receive a general introduction program. This consists of pre-visit materials, an introduction to zoos and wildlife conservation, and post-visit materials. It is hoped that by whetting their appetites they will then schedule one of their field trips out to the zoo where they can receive more specific programming.

The secondary teacher can schedule any one of a number of programs that meet their individual curriculum needs.

The vehicle that was purchased is a 1985 12 passenger Chevrolet Sport Van. It has a one-ton chassis with a four speed automatic with overdrive. Options purchased include a luggage rack, heavy-duty suspension system, rear air-condiitioning, cruise control, and solar-cote tinted windows.

The seats are removable to facilitate transporting animals in Vari-kennels. Usually the first bench seat is all that needs to be removed. The floor is heavy-duty vinyl for easy cleaning. There is also a fire extinguisher, flare kit, and first-aid kit. A travel log and receipt book are kept in the glove compartment for the docents to fill out every time they do a program.

Initially insurance seemed like it was going to be a major obstacle but the City of Waco finally researched their policy and said that the Docents were covered as long as they were performing zoo business and went directly to and back from their program location. The Docents did have to provide proof of their own personal insurance coverage, (for litigation purposes should an accident occur.) Also they have to show proof of a valid Texas state driver's license.

Program participants travelling in the zoomobile are covered under the city's insurance policy as long as it is within the state of Texas. Outside of the state a rider must be purchased to cover the students.

There were a number of funding sources considered and the Junior League of Waco was finally chosen to apply for the grant. The League has supported the Central Texas Zoo for many years and was the organization responsible for funding the education department at its inception.

Also the League provides many volunteers to the education department every year.

The League requested that the grant be written outlining the purpose of the vehicle, who would benefit from it, cost of such a vehicle (list of bids), future commitment of the League after initial funding, and how would it address the needs of the community. After initial approval by the League's Board of Directors the proposal was sent to the general membership for a vote.

Animals being used for the program currently are as follows:

1.) Boa constrictor, (Boa constrictor constrictor)

2.) Corn snake, (Elaphe guttata)

3.) North American kestrel, (Falco sparverius)

4.) Screech owl, (Otus asio)

5.) Great horned owl, (Bubo virginianus)

6.) European ferret, (Mustela putorius)

7.) Pygmy hedgehog tenrec, (Echinops telfairi)

8.) Virginia opposum, (Didephus marsupialius)

These animals are rotated and all are not handled by the students. This judgement is left up to curator of education and the docents taking individual animals out determining their daily dispositions.

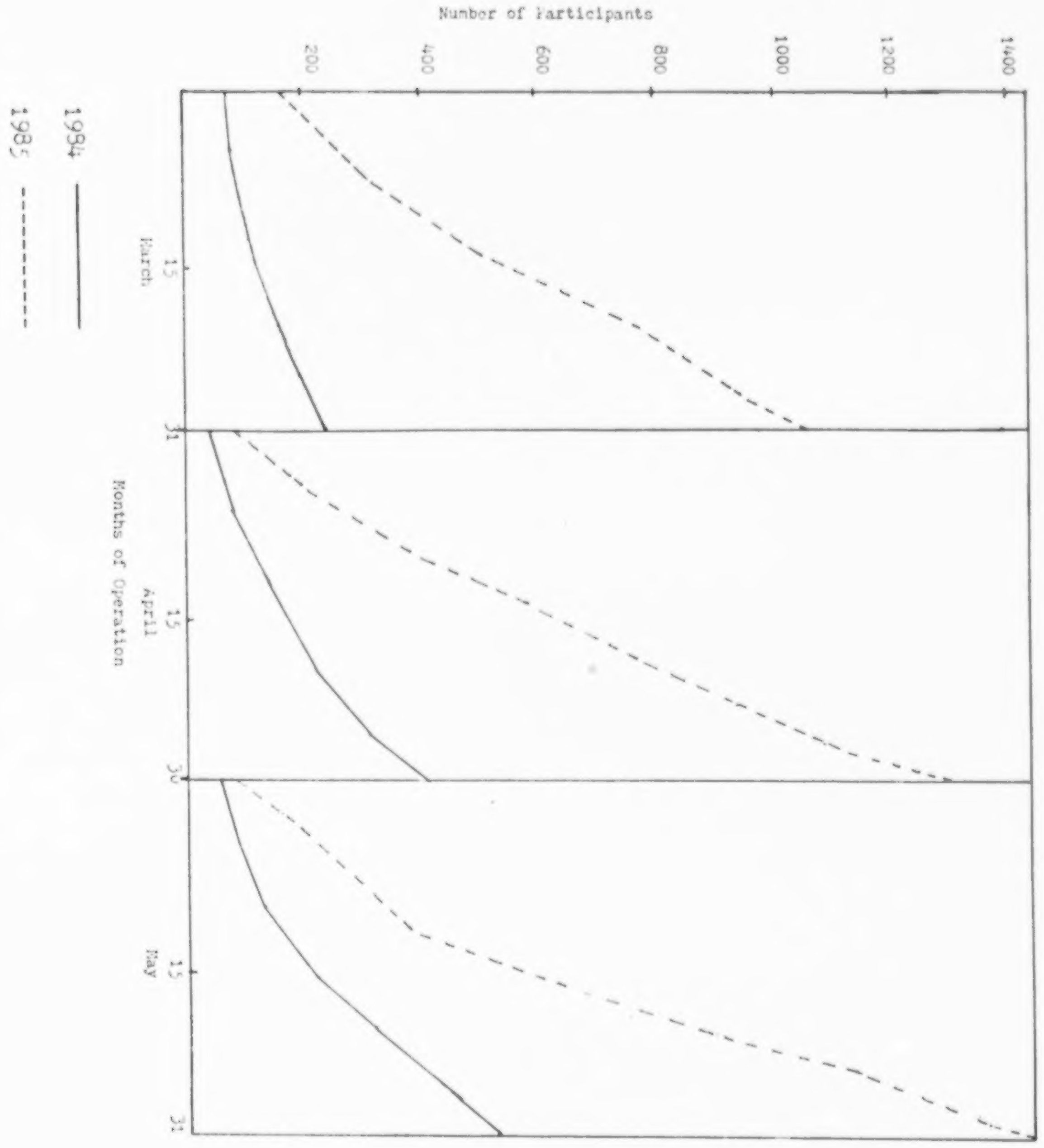
As with the regular in-house programs the docents that go out with the zoomobile go through an extensive training program as well as a driver education program.

In the first three months of operation (March, April, May 1985), there was a ten-fold increase in the number of people receiving programming on an out reach basis. Follow up visits by classes receiving zoomobile visits and requesting programming at the zoo also increased.

The zoomobile has been a definite plus for the Central Texas Zoo because it offers students and other participants to take advantage of the zoo's resources. It allows the student and teacher to see what the zoo is as a conservation tool and also how it can be utilized in many aspects of the teacher's lesson plans and curriculum.

Fig. 1

Numbers of participants in out-reach programs*



1984 no zoomobile
1985 with zoomobile

HIRE THE K-TEAM

Barbara S. Moses
Curator of Education
Memphis Zoo and Aquarium

I am employed by a micro-zoo. The Memphis Zoo and Aquarium is micro in size (36 acres), micro in budget dollars ($2,067,429) and micro in personnel (64 full time staff). We have a skeleton staff. No, our staff is not underfed. But at our micro zoo, you won't find a curator of exhibits, graphics specialist, research assistant, marketing director, librarian or volunteer coordinator. At the Memphis Zoo, we have three animal departments, a business office, a veterinarian and a maintenance/grounds department. If a job or task does not pertain to animals, the budget, plants or plumbing, then it falls to the Education Department. Like many micro zoos, we do not have the luxury of employing specialists.

Despite our micro zoo status and the absence of specialists on our staff, we do have "mega goals". At the Memphis Zoo, we think big. To enumerate a few of these goals:

* To become the top attraction in a city synonymous with Elvis Presley, Beale Street and barbeque ribs.

* To attract Memphians to the Zoo who have not been there in years, even decades.

* To entice the non-zoo goer into our park.

* To generate additional revenue dollars without raising admission fees.

* To provide an educational yet entertaining experience for both the general public and school children.

* To expand publicity about the Memphis Zoo around the world.

The opportunity to fulfill these goals came this year, 1985. The Memphis Zoo was scheduled to exhibit a koala as part of the City's month-long salute to Australia during the annual Memphis in May International Festival. This temporary exhibit appeared to be the perfect solution . . . or so we thought.

Prior to this time, only three zoos had temporarily displayed koalas. By definition of size, these institutions could be classified as "mega zoos". We listened to these zoos' experiences and began to wonder if we made the right choice. Here at the Memphis Zoo, not only were we to display a koala but also highlight Australian flora and fauna at several exhibit areas. We faced a number of limiting factors. Developing a major theme exhibit, even if it is temporary, takes money and time.

With the fiscal year half over, our budget looked rather anemic and the project time frame was shrinking daily. Schering-Plough, Inc. makers of Coppertone Suncare Products and St. Joseph medications for children, came to our rescue with an agreement to underwrite the project for $34,000. However, time was still a factor. We received official confirmation from the San Diego Zoo about the koala loan in January. We had four months to put the project together.

The koala exhibit building needed major renovations to accomodate the guest of honor. The loan agreement with the San Diego Zoo mandated that the exhibit area must be climate controlled,enclosed, adequately buffered from the public and furnished with communications and other specialized equipment, including tree perches made to precise specifications. Normally, these renovations should not have presented a problem except Memphis experienced one of its worst winters in decades. Snow and sub-freezing temperatures thwarted construction.

So here was our dilemma:

-- We had to take this building, vacant and unused for a number of years.

-- Prepare it for the arrival of this creature.

-- Entice visitors to our gates.

-- Give them a memoriable experience.

-- Complete all preparation within four months

-- And not go over budget

This project seemed like Mission Impossible to our micro zoo staff. The work demanded specialists. We had none. So, how did the Memphis Zoo respond to this crisis? We hired the K-Team.

This afternoon, I would like to introduce you to the members of the K-Team and briefly explain how they successfully pulled off the Memphis Zoo's "Koala Kaper".

First, this enthusiastic and energetic member of the team is **Phillip " I can handle it" Norfleet.**

Norfleet, world renowned horticulturist and weekend handyman, is noted for his ability to keep plants alive and healthy.

As a member of the K-Team, Norfleet was responsible for the tasteful landscaping of the exhibit and other areas in the Zoo with Australian flora.

In addition, he inspected the twice weekly shipments of eucalyptus to ensure it was edible.

As head of the maintenance crew, Norfleet personally supervised the hanging of our signs and labels.

Another member of the K-Team was Cecil B. deMoses [a.k.a. **Barbara Moses**], information specialist and sometime movie producer. Moses was challenged to peak the public's curiosity about the Koala Kaper.

So, she bombarded the South Central United States with a series of innovative press releases - **"Koala Kwips"** - with such provocative titles as "There is No Such Thing as a Koala Bear" and the "The Devil is Coming to the Memphis Zoo".

Another challenge was handling the anticipated crowds and how to entertain visitors waiting in long lines to view the sleeping koala.

Moses settled on a special video production. . .

Which would be viewed at three stations leading to the Koala exhibit [Incidently, the fifteen minute video presented $8000 - $10,000 of production time but only cost the Zoo $19.50].

When it came to stocking the exhibit with other rare creatures from Australia, it was only natural to call in team member, **Dr. Charles Brady.**

Brady can track down and bring back alive the most unusual and elusive of Australian fauna.

Among his trophies were these Siamese twin Ladder Kangaroos.

And this rare housebroken Tasmanian Devil. . .

Who came with its own litter box.

Signs and labels are an important part of interpreting exhibits. Brady again demonstrated his multi-facet talents when he secured the talents of a local artist to produce a four-color graphic panel for the koala exhibit.

This panel is now the K-Team's legacy to the Host-a-Koala program.

Another member of the team was **Wayne Carlisle** who supervised the renovation of the future Australian Pavilion.

To ensure specifications were met, Wayne worked with elaborate and detailed architectual plans. [You realize I have been poking fun at our staff, but, seriously, this is the actual drawing used for directing the renovations!]

To keep communications open with the corporate sponsor and to juggle the accumlating bills, team member Ms. "T" (a.k.a. **Patricia Tolbert**) was called in.

Ms. "T" also mobilized Zoological Society manpower with such motivating phrases as: "I pity the fool who doesn't volunteer for this assignment".

Last, but not least, is the illustrious leader of the K-Team, **Charles "Mr. Charm" Wilson.**

Charles was able to secure funding from Plough, Inc. for the exhibit with a promise to personally test Coppertone products.

Who else but Mr. Charm could have persuaded the Mayor of Memphis and corporate officials to help prune the Zoo's shrubs when we were short staffed.

During the entire Koala Kaper, no job or task was too burdensome or demanding for Charles. Whether if was posing with cute young things. . . koalas, that is, . . .

Or auditioning Australian Aboriginal dancers, Charles was a model leader and an inspiration to us all.

I thank you for allowing me to indulge in this tongue in cheek look at the problems and challenges of a mirco zoo. The Memphis Zoo and Aquarium may not have the budgets dollars to hire specialists like the K-Team but we compensate for the deficiency by successfully tapping the talents and creative abilities of our staff. Through this special promotion, Koala Kaper, the Zoo staff proved that they could work together as a team to accomplish goals. Thus seemingly limiting factors as small budget, acreage and personnel need not be deterrents in undertaking major projects.

Through the efforts of the K-Team, the Memphis Zoo was rewarded in numerous ways. In the fiscal year 1984-85, the Memphis Zoo was the top city attraction with 579,582 visitors. [Yes, we beat out Graceland!] In May alone, we had over 155,000 visitors. Of course, these high attendance figures translated into increased revenue for the Zoo.

Informal visitor surveys revealed that news of the Koala Kaper reached well beyond the greater Memphis area and that these visitors had come to Memphis specifically to see the koala. You can imagine our surprise and delight to learn that a Queensland, Australia TV station have carried a feature about the Memphis Zoo and its special exhibit. The Memphis Zoo was recognized on the other side of the world.

The surveys also revealed that the Koala Kaper attracted first-time visitors and enticed back people who had not been to the Zoo for years. Comments such as "I haven't been here in years and things sure have improved". "The grounds never looked so good", and "This is the first time I've been to the Zoo", were often heard by staff and volunteers.

Yes, through the assistance of the K-Team (and all the staff-- paid and volunteer), the Memphis Zoo and Aquarium had indeed met its goals.

In June, with the koala safely back in the San Diego Zoo, the K-Team disbanded and the Memphis Zoo staff went back to their normal routine. However, minds began to ponder and plan projects for next year's Memphis in May featured country Japan. How do you top a koala?. . . Does anyone know if Godzilla is available for loan?

ENDANGERED BIRDS OF GUAM

Larry C. Shelton, Curator of Birds
Philadelphia Zoological Garden
Philadelphia, Pennsylvania

Mention the name Guam, and most people have some vague idea about its being a small tropical island in the western Pacific. Some may even know that it is also a U.S. territory, and a few older individuals may even have World War II recollections of the island. That's about it

And, until the Jean Delacour IFCB Symposium in Los Angeles in February 1983, that's about all most of us in this room also knew. It was then that Robert Beck, a wildlife biologist from Guam, brought the plight of the island's avifauna to the attention of several of us. The birds of Guam were disappearing -- in fact, fast disappearing -- and no one then knew why. As a result, Beck was on a desperate mission to interest mainland zoos in the propagation of the island's endemic bird life until the cause(s) of the precipitous decline could be discovered and controlled. He fully believed that, unless a captive propagation program was soon started, the entire Guam avifauna including six endemic species and subspecies was doomed to imminent extinction. These six endemics were the bridled white-eye (Zosterops c. conspillata), rufous-fronted fantail (Rhipidura rufifrons uranie), Guam broadbill (Miagra freycinetti), Mariana crow (Corvus kubartschi), Micronesian kingfisher (Halcyon c. cinnamomina) and Guam rail (Rallus owstoni). How right he was, for the first three species became extinct or so nearly extinct as to be beyond saving within six months of that conference. And, although the rail is being successfully raised in captivity by the Guam Division of Aquatic and Wildlife Resources and the Bronx and National Zoos, this species also evidently became extinct in the wild this year. Only eight pairs and a few odd males of the kingfisher now remain in the wild; however, there are 26 specimens in captivity of which five were raised in captivity this year -- two at the Bronx Zoo, two at Front Royal and one at the Philadelphia Zoo. The crow population is now estimated to be 200 or less, with a small population on the neighboring island of Rota. As for the other six non-endemic species of land birds there, they are also fast disappearing and apparently in some species, such as the cardinal honeyeater, only males are left.

Looking back on the initial meeting with Beck in 1983, I doubt that those of us -- especially, Ed Schmitt, Don Bruning, Chris Sheppard, Guy Greenwell and me -- who were intrigued and horrified by this tale of impending ecological disaster knew the full magnitude of what we were getting ourselves and our institutions into . . . only fools, angels and bird curators is how I think the line goes! And, if we had known the full implications, I'm sure that we would have proceeded as we did, for the Guam Bird Rescue Project is developing into one of the most challenging and most complex avian conservation efforts of our time. And it is a project that is going to require the participation of many more mainland zoos. The project up to this point has been implemented mostly by the Philadelphia, Bronx and National Zoos, with lesser participation on the part of the San Antonio, St. Louis and Denver Zoos.

But why are the birds of Guam disappearing?

At the first meeting with Beck in 1983, the Guam wildlife officials had already ruled out pesticides as being responsible for the decline. By the time when I made a field trip to Guam in July 1983, diseases had been also practically discounted. However, a culprit had begun to appear through circumstantial evidence. The brown tree snake (Boiga irregularis) had been introduced, accidentally or deliberately, into Guam in the late 1940's. The areas in which the snake had first appeared were the same areas in which the native birds had also first disappeared! This had come to light through research by Julie Savidge, a research biologist with the Guam Division of Aquatic and Wildlife Reources. By 1983 the native land birds were confined to the northern third of the island, the last area which the snake had invaded. Examination of snake stomach contents by Savidge were also revealing large quantities of bird and bird eggs.

An entire insular avifauna being destroyed by a snake -- it sounded incredible! But it has proved to be fact.

John Groves, the Philadelphia Zoo's Curator of Amphibians and Reptiles, expressed doubt at my report upon my return from Guam. However, after he made field studies in Guam in March 1984, he became fully convinced that this introduced snake with no natural enemies in its new habitat was indeed the villain causing the decline of this avifauna previously totally naive to snake predation. He estimated that the snake population had exploded to a size of at least one million -- this on an island only 20 miles, north to south, and 10 miles, east to west!

Since then extensive field work by USFWS biologists, led by Tom Fritz, has given overwhelming confirmation that the introduced snake caused and is continuing to cause the extinction of the Guam avifauna. Fritz even estimated the snake population to be as high as three million. The FWS biologists, in conjunction with local Guam DAWR biologists, are working on methods to reduce the snake population and prevent its accidental introduction to nearby islands where it could create similar ecological havoc. However, sufficient control of the snake for a reintroduction program is not going to be an overnight affair. And this places a genuine challenge -- and an exciting and rewarding one -- to mainland zoos which participate in the Guam Bird Rescue Project. The AAZPA Committee for the Guam Bird Rescue Project consists of Charles Pickett, National Zoo, Kevin Bell, Lincoln Park Zoo, and me.

As I stated earlier, three institutions -- the Philadelphia, Bronx and National Zoos -- have been the prime movers thus far in the Guam Bird Rescue Project through investment of facilities, personnel, time and monies. In addition to the field trips by John Groves and me to Guam, the Philadelphia Zoo has paid for the transportation of Guam birds and Beck to the mainland, created a quarantine area with one-way glass for observation of newly arrived birds, is building two small conservatory aviaries for Guam birds, and is sending Gary Michael, a staff aviculturist, to Guam this month for a minimum of 6-8 weeks to study the Mariana crow in the field. The National Zoo sent Eugene Morton for field studies of Guam rail in the spring of 1984, and is devoting a large amount of space in a new structure at Front Royal to propagation of Guam birds. The Bronx Zoo has devoted much space on and off-exhibit for the propagation of Guam species and shared the cost with the National Zoo of a four-month field study of the Micronesian kingfisher by Sam Marshall, a former Bronx Zoo employee. As the Guam Bird Rescue Project becomes more of a success, there must be more participants which have the space and expertise to work with these species. As mentioned earlier, the San Antonio, Denver and St. Louis Zoos are already participating in the program.

And, to repeat, what an exciting and rewarding program to be a part of!

Unlike the case with most, if not all, present SSP species, we are not starting with a genetic bouillabaisse created by unplanned breeding in the past. Instead, we have the unique opportunity from square one to plan models for the propagation of the three remaining Guam endemics. Unfortunately, the founder population of the rail is small, but Scott Derrickson will discuss this species in detail later.

Of 21 kingfishers brought to the mainland in January 1984 and November 1984, only one specimen has died, and only recently, and five pairs have already successfully nested. Dealing with a population whose ages are unknown, this has indeed been remarkable. Right now Guam wildlife biologists are engaged in trapping as many of the remaining kingfishers as possible to send to the mainland. The Philadelphia, National and Bronx Zoos have documented the captive breeding biology and other behavior of the species, and the field data gathered by Marshall can complement this.

Although no Mariana crows are in captivity now, plans are now being made to bring two pairs to the Philadelphia Zoo for a propagation attempt in October. This attempt will be augmented by the field studies of Michael this fall done in conjunction with Guam DAWR personnel.

Again, unlike the case with most other endangered species, we are working with the officials of a U.S. territory, not those of a third-world nation. Although the captive propagation program for Guam birds is in its infancy, Guam officials themselves have already developed a well-thought-out, long-range conservation and reintroduction proposal for its endangered avifauna. What a contrast to so many other cases where outside forces have had to be a catalyst!

To participate in the Guam Bird Rescue Project is truly an opportunity to approach a conservation problem from the correct perspective from the beginning. For a change, we aren't stumbling into a situation where most of the initial effort has to be devoted to undoing the damage which lack of planning in the past has created. Instead, we can concentrate on the scientific captive management of the three species until the appropriate time for a reintroduction program occurs.

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THE PEREGRINE FALCON RETURNS TO LOS ANGELES

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Although never an abundant species, the peregrine falcon (Falco peregrinus) flourished in the United States prior to World War II. Aside from some disturbance from encroaching civilization, historical eyries continued to be successfully occupied each year. East of the Mississippi River there were as many as 209 breeding pairs (Berger et al. 1969). In California there were 98 known eyries (Herman 1971), and there may have been as many as 246 active eyries in the rest of the western states (Cade 1975).

Unnoticed except by a few astute falcon watchers, the resident peregrine population in the United States declined drastically during the late 1940's and through the 1950's. Eyries long known for their dependability suddenly began producing fewer young and eventually were found to contain only broken eggs. After a few years even the adult birds disappeared. By 1964 the peregrine falcon was extinct east of the Mississippi River (Berger et al. 1969). A survey of a large percentage of the known peregrine eyries in California yielded less than 10 that were still active by 1970 (Herman 1970). In the other western states perhaps only 40 peregrine nests were still active by this time (Cade 1975). This disastrous turn of events led in 1969 to the resident race of the peregrine, Falco peregrinus anatum, being officially listed as an Endangered Species.

The cause of the peregrine's decline, which was a worldwide phenomenon, was demonstrated by the British researcher, Derek Ratcliffe (1967), who showed that the eggshells of peregrines had become so thin that the weight of the incubating bird crushed the eggs. He concluded that this was due to the effects of DDE, a breakdown metabolite of the pesticide, DDT, in the laying female. DDT was first used in the United States in 1946, shortly before the decline of the peregrine began in this country. An ingenious laboratory technique devised by David Peakall (Peakall 1974) verified that museum specimens of peregrine eggs collected in California in 1948 already contained enough DDE residue to account for their thin shells. A global survey of eggshell thickness and DDE residues in peregrine eggs (Peakall and Kiff 1979) revealed that peregrines have suffered eggshell thinning throughout their cosmopolitan range since the introduction of DDT in the mid-1940's, and the amount of thinning is invariably correlated with the amount of DDE residues in the eggs.

In response to the plight of the peregrine, Tom Cade, Heinz Meng, and others formed The Peregrine Fund at Cornell University in 1970. A facility was built for the purpose of developing captive peregrine propagation methods, raising peregrines, and later releasing offspring into formerly occupied habitat. Four years later James Enderson, William Burnham, and others built a second facility at Fort Collins, Colorado. In the mid-1970's Dr. James Roush and his associates, mostly falconers, formed the Santa Cruz Predatory Bird Research Group (SCPBRG) at the Universtiy of California, Santa Cruz. Brian Walton subsequently became the full time Coordinator of the SCPBRG and still serves in that capacity (L.F. Kiff, pers. comm.). In 1982 the SCPBRG officially became part of The Peregrine Fund.

By 1975 The Peregrine Fund facility at Cornell had produced enough captive-bred offspring to permit releases into the wild. The principal release method chosen was a traditional falconry technique known as "hacking". When peregrines are hacked, 35-day old chicks are placed in a large box that is completely enclosed except for vertical bars on one side and a food chute in the top. The box is placed on the actual release site, usually on a mountain cliff, a man-made platform overlooking a natural uninhabited area, or in urban "canyons" of steel, concrete, and glass. The chicks remain in the box for the next week. During this period the young falcons are fed by hack site attendants in a manner that prevents them from associating food with humans, and they typically exercise their wings and observe the world outside their barred home.

When the chicks are 42 to 45 days old, the same age at which they fledge from natural sites, the barred wall is removed from the hack box, and the young are free. While the fledglings are learning to be peregrines, the attendants continue their covert feeding regimen. When the young birds learn to feed themselves, a process usually requiring four to six weeks (Sherrod et al. 1981), the artificial feedings are stopped, and the young falcons are allowed to fend for themselves. In California the young peregrines normally leave the release area at this time and are often not seen again until the subsequent breeding season.

In 1981 the Western Foundation of Vertebrate Zoology (WFVZ), a research-conservation organization in Los Angeles, arranged with the SCPBRG to fund and coordinate a peregrine falcon release program in Los Angeles for three years. Peregrines were last seen in Los Angeles county between 1943 and 1947. During the fall and winter of those years there were many sightings of peregrines perching on the Pasadena City Hall and hunting in the surrounding area (H. Cogswell, pers. comm.). The WFVZ hack site was located in Westwood near the UCLA campus on the west side of Los Angeles. The hack box was placed on top of a 21-story office building (which not coincidentally also houses the offices of the WFVZ).

Amidst a flurry of local publicity, three young peregrines, a female and two males, were successfully hacked from the Westwood site in 1981. Through its history, the urban release program has generated a good deal of public interest in the peregrine, and we consider this to be highly beneficial to the welfare of the species as a whole.

I joined the staff of the WFVZ in 1982, and one of my earliest assignments was to assist in the release of three more peregrines during that summer. This release was accompanied by some difficulties. On the first day of the release, the program suffered its first loss. A strong gust of wind swept one of the young peregrines off the roof of the office building before it would normally have taken to the air. After several crash landings made while attempting to return to the hack box, the exhausted fledgling crashed for the last time into the side of a glass-covered sdyscraper. The two remaining falcons, one male and one female, stayed in the area of the hack site until an adult male peregrine made his appearance 28 days after the release. The young peregrines appeared to be quite frightened by the adult, and the next day was the last date that the young female was seen in Westwood. The young male hung around for the next week, but seemed to lose interest in staying near the hack site after the female disappeared.

In 1983, the last year that peregrines were released in Westwood, I was the lone hack site attendant. This release turned out as well as the first one, and three more peregrines were added to California's growing urban falcon population.

An adult male peregrine established residence among the skyscrapers of downtown Los Angeles in mid-1982, and by the following spring he had acquired a mate. This pair eventually chose the 40-story Union Bank building as its home base. Meanwhile, a second pair of peregrines established themselves on a 27-story California Federal Savings and Loan office building near the La Brea Tar Pits, approximately six miles west of the downtown pair. Both buildings possessed a number of features which evidently made them attractive to peregrines, including great height, prominent ledges, and an abundant local pigeon population.

Close-up photographs of the Union Bank birds by interested birders eventually confirmed that the male was one of the falcons released from Westwood in 1981 and the female was from the WFVZ hack site in 1982. The California Federal birds, although both were banded, have yet to be identified. No breeding occurred at either site in 1983, but for different reasons. The Union Bank female presumably was too young (peregrines normally do not breed prior to their second year). It is probable that the California Federal pair was inhibited from nesting in 1983 because of unusually stormy spring weather for California, and possibly the large amount of attention they attracted from well meaning observers. Suitable nest trays were placed on favorite ledges on each building in anticipation of next years breeding season. The nest trays provided for the peregrines were simply shallow boxes made of lumber and filled with pea gravel. These provide the female peregrine with the raw materials to scrape out the shallow impression which serves as the nest.

I looked forward to the breeding season of 1984 with mixed feelings. How was I going to monitor two peregrine nests by myself? Unfortunately, this potential dilemma was solved in a way that I had not expected. Everything seemed to be progressing well at the California Federal site -- the birds were hanging around the nest trays, and the female was getting "dumpy" and seemed ready to lay at any time. And then came the unbelievable surprise -- she simply disappeared.

The disappointment I felt was quickly swept aside by the report of the first egg being laid at the Union Bank site. This egg was followed by an additional one every other day until the usual clutch of four eggs was completed. Through fellow peregrine watchers, I obtained permission to use a reading room in the 45th-floor law library of the nearby Atlantic Richfield Company building as an observation post. I then settled down to watch what I hoped was to be a normal peregrine nesting. This hope was not to be realized. On the 20th day of incubation the male peregrine tossed a broken egg out of the nest onto the ledge below. The next day only two eggs remained in the nest. It was clear that something would have to be done, or the nesting attempt might be a total failure.

At this point, Brian Walton of the SCPBRG, who was following events closely, decided that he would have to intervene. Two days later he flew down from Santa Cruz with a portable incubator, and we took this out onto the nest ledge to replace the two peregrine eggs with four artificial eggs. While several TV cameras and numerous observers watched from various vantage points in adjacent office buildings, the incubating female peregrine incredibly sat stubbornly on the scrape while Brian actually reached under her and made the exchange. The viable eggs were taken back to the Santa Cruz facility for artificial incubation, while the artificial eggs served to hold the peregrines to the nest scrape. Ten days later Brian returned to Los Angeles, and we exchanged a pair of two-week old female peregrine chicks for the four artificial eggs (older chicks are used in such situations because they have a stronger begging response and because they are less likely to be injured by an excited peregrine returning to the nest and finding "instant hatchlings"). As is invariably the case, the chicks were readily accepted by the adult peregrines, and the nesting proceeded normally until the chicks fledged.

The nestling peregrines fledged thirty-two days after they were placed in the nest tray. As is typical of wild peregrine nests, the Union Bank pair experienced fifty percent fledgling success. After a rocky start, one of the fledglings progressed normally and was last seen soaring high over the tops of the highest buildings in Los Angeles. The other fledgling was not so lucky. After a head-on collision with a mirrored building (a hazard unigue to urban peregrine nests), the young bird was found and eventually moved to Santa Cruz. There its severe head injuries were repaired, and the bird is now a part of the captive breeding stock at the SCPBRG.

In 1985 the spotlight moved from downtown Los Angeles to the La Brea, or California Federal site. Just as had been the case during the previous year, the Union Bank female disappeared just prior to nesting. Meanwhile, the California Federal male had picked up a new mate during the winter. This female has turned out to be important for two reasons: she is a product of the SCPBRG program, and she was released at a "wild" hack site on the Big Sur coast of central California.

A nesting attempt was eventually made at the California Federal building, and it turned out to be strikingly similar to the previous year's experience on the Union Bank. An egg was broken almost immediately, and manipulations involving "dummy" eggs and substitute chicks were made. Again, one of the two fledglings flew into the glass side of a high-rise and was killed. The other fledgling apparently achieved independence without mishap.

While this was going on, the Union Bank male recruited another female, an immature bird that had been released from a wilderness hack site in the nearby Santa Monica Mountains. This bird will be of breeding age next year, and it is hoped that we can actually achieve a breeding population of two pairs simultaneously in Los Angeles.

We have recently learned of the possible fate of the two female peregrines that disappeared so mysteriously. It has been reported that disgruntled roller pigeon fanciers have claimed credit for shooting these two birds and several others in the Los Angeles area. Because of the unique flying habits of roller pigeons, they are particularly vulnerable to peregrine attacks and there is no doubt that the peregrines have severely damaged local roller pigeon flocks. The peaceful co-existence of the falcon and the pigeon breeders in Los Angeles does not seem probable at the time of this writing.

Aside from this single, possibly critical mortality factor, it seems clear that peregrines can do well in a modern urban environment. Even including the losses of birds flying into mirror-sided buildings, survival of the falcons released in Westwood has been much higher than might have been expected. However, our original expectation that peregrines living in cities might have cleaner diets (in terms of pesticide residues) and therefore enjoy better eggshell quality than their rural counterparts has not yet been realized. Apparently, it will continue to be necessary to manipulate the peregrines in Los Angeles if they are to reproduce successfully. Finally, it is very encouraging to note that rural birds can be attracted by city birds, since this implies a considerable amount of movement throughout the state on the part of birds looking for a mate.

On other fronts 1985 has turned out to be a great year for the peregrine falcon recovery program. The Peregrine Fund facility at Cornell hatched 125 peregrines for release to the wild. The newly constructed "World Center for Birds of Prey" (which has incorporated the peregrine facility formerly at Fort Collins) in Boise, Idaho is just completing its first breeding season and should raise 160 peregrines this year. The number of adult pairs found in the wild is increasing dramatically. In the East, 39 pairs have been located, and some of these are at long abandoned eyries in New York, Vermont, and New Hampshire. In California, there appear to be as many as 80 resident pairs active this year (Cade and Dague 1985).

If the current growth rate of continental peregrine populations continues through 1990, the number of pairs in the eastern United States should approach pre-DDT numbers (Cade and Dague 1985). However, continuing eggshell thinning problems in California and other western states make it necessary to continue to manipulate resident peregrine populations artificially in order to sustain them. Therefore, I am forced to leave you with this sobering thought: DDT, although banned for domestic use in the United States, Canada, and most western European countries, continues to be widely used in most of the world's tropical regions, primarily for agricultural purposes (for which it was not originally intended). As long as this single chemical remains in the life support system of this planet, the peregrine falcon will continue to lay thin-shelled eggs on the steel and concrete ledges of buildings in Los Angeles and in remote eyries like the one on the sheer granite face of El Capitan in Yosemite Valley. It is through our collective diligence, hard work, and caring that we have brought the peregrine falcon back to where it is today. We cannot relax yet.

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A Cooperative Breeding Program for the Guam Rail (Rallus owstoni)

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The Guam rail (Rallus owstoni) is a flightless species, endemic to Guam of the Mariana Islands. Historically, rails were distributed over the entire island, with the highest densities occurring in scrub, second growth, and mixed woodland habitats (Jenkins 1979, 1983). During the 1960's, the wild population was estimated in the tens of thousands (Lint 1968), and appeared to be increasing due to habitat modification and the introduction of an African snail. Numbers began to decline dramatically soon thereafter, and by the mid-1970's censuses by the Guam Department of Aquatic and Wildlife Resources (GDAWR) indicated that rails had disappeared from southern Guam and the central portion of the northern plateau (Jenkins 1979). By 1981, the species was restricted to two localized areas in northern Guam, with the highest concentration occurring on Andrews Air Force Base. Between 1982 and 1984 the population declined by over 80 percent, and the rail was placed on the U.S. Endangered Species List on an emergency basis (U. S. Fish and Wildlife Service 1984a). Endangered species status under the U.S. Endangered Species Act of 1973 was granted on 27 August 1984 to the Guam rail and six other avian species, including the Guam broadbill (Myiagra freycineti), Mariana crow (Corvus kubaryi), Micronesian kingfisher (Halcyon c. cinnamomina), and Bridled white-eye (Zosterops c. conspicillata)(U.S. Fish and Wildlife Service 1984b). Unfortunately, the Guam braodbill, the Bridled white-eye, and the Rufous-fronted fantail (Rhipidura rufifrons uraniae) have now virtually disappeared from the island and are presumed to be extinct. The Guam rail is rapidly approaching extinction in the wild as well -- only 2 individuals could be located by GDAWR personnel in June 1985 (R.E. Beck, pers. comm.).

The decline of Guam's native avifauna has been attributed to a variety of factors, such as habitat loss and modification, pesticide contamination, introduced diseases, and predation by introduced vertebrates. Research efforts are currently being focused on avian diseases and an introduced predator, the Brown tree snake (Boiga irregularis). This snake occurs naturally in the Indo-Malayan archipelago and apparently was accidentally introduced to Guam in the late 1940's or early 1950's. As noted by Savidge (1984), the south to north expansion of the snake parallels the observed range contraction and decline of Guam's forest birds. At present, native bird populations are restricted to mature limestone forest and secondary growth habitat at the northern end of the island where the snake is rare or absent.

In 1982, the GDAWR decided to establish captive breeding populations of several species in order to preclude extinction and ultimately to provide stock for reintroduction. To minimize the risks associated with having all birds housed at one location, a cooperative program was subsequently initiated between the GDAWR and several U.S. zoos through the American Association of Zoological Parks and Aquariums (AAZPA). Thus far, capture and propagation efforts have been focused on the Guam rail and the Micronesian kingfisher, and both species are being successfully maintained and bred in captivity (Shelton 1984, Sheppard 1985).

This paper briefly discusses the current status of the propagation program for the Guam rail, and provides a general summary of captive management and husbandry procedures. Particular attention is given to mortality factors, housing requirements, captive diets, and sex determination.

History and Current Status in Captivity

The first documented breeding of the Guam rail in captivity occurred at the San Diego Zoo (SDZ). Ten birds were acquired from the Government of Guam in 1968 (Lint 1968). Although several birds died soon after arrival, the surviving rails were all placed in a large, heavily plants aviary (K. C. Lint, pers. comm.). Between July 1968 and early 1976, at least 28 chicks were successfully hatched in the exhibit. The last rail in the collection died sometime in 1980. Interestingly, this bird - a female - was one of the original rails obtained in 1968, and was at least 12 years old at the time of her death (Jenkins 1979, M. L. Jones, pers. comm.).

As part of the current rescue project, rails were captured and taken into captivity beginning in March 1983. Most birds were taken from the wild as chicks or subadults; a few were hatched from collected eggs and hand-reared (R. E. Beck, pers. comm.). Initially, all of the birds were held at the GDAWR facility in Guam; however, transfers to mainland zoos began in March 1984 when 4 rails were transported to the National Zoological Park's Conservation and Research Center (CRC) in Front Royal, Virginia. In November 1984, an additional 8 birds were transferred to CRC and 4 birds were transferred to the Bronx Zoo. Captive-bred rails are now being hatched and raised at all 3 locations. First hatchings occurred in 1984 at GDAWR and CRC, and in early 1985 at the Bronx Zoo. There are currently 52 Guam rails in captivity: 15 at the GDAWR facility; 22 at CRC; and 15 at the Bronx Zoo.

Mortality in Captivity

To date, 16 post-mortem examinations have been conducted on captive Guam rails. Necropsy results are summarized in Table 1.

Guam rails are extremely territorial, and incidents of fighting have been reported in the wild (Jenkins 1979). Four of 5 captive birds have been lost to traumatic injuries apparently resulting from intraspecific aggression. The single bird lost at CRC was a one-year old male that had been caged continuously with his male sibling without incident both at GDAWR and CRC. Hostility in this instance appeared suddenly and without warning. Fortunately, in several other sibling groups chasing was observed and the birds were separated before mortalities occurred. The 3 rails lost to aggression at SDZ included 2 adults and 1 juvenile. In the large aviary at SDZ, many additional mortalities probably resulted from aggression. Although post-mortem examinations were not conducted, available records indicate that many birds were being lost around 4-5 months of age. Young birds assume adult plumage at about this time (Jenkins 1979).

Four adult rails at SDZ apparently succumbed to bacterial infections (i.e., ventriculitis caused by foreign body; enteritis/airsacculitis; enteritis/myocarditis; and oophoritis).

Interestingly, 2 chicks have apparently died of drowning -- a situation that has previously been documented in young captive Sora rails (Porzana carolina) (Kaufamann 1977). This mortality can obviously be avoided by making certain that water containers and ponds are designed to provide chicks with easy entry and exit.

Breeding Enclosures

All pairs in the present breeding program are being maintained in separate cages in order to avoid the possibility of intraspecific aggression and the production of progeny of unknown parentage. Guam rails are not difficult to breed in captivity, and have adjusted well to relatively confined quarters both on and off exhibit. At the GDAWR facility, the outdoor breeding enclosures measure approximately 3 m suare and 1.2 m high, are covered with hardware cloth and shade cloth, and are densely vegetated. The typical breeding enclosure at CRC is 3 m wide, 6 m long, and 3.6 m high, and live plants and cut bamboo are used to provide adequate escape cover and security. Breeding enclosures at the Bronx Zoo are similar in size to those in use at CRC. One breeding pair is currently being held off-exhibit at the Bronx Zoo, while the other is on public display in their World of Birds exhibit.

To minimize the potential for fighting and aggression, captive pairs should be maintained in visual isolation. Breeding pens are separated by about 30 m at the GDAWR facility in Guam. At CRC the individual enclosures are separated by a solid partition wall.

Diets

The Guam rail is ominivorous, and apparently prefers animal over vegetable foods. In the wild, gastropods, insects, geckos, and carrion are regularly consumed along with a variety of seeds and palm leaves. Gastropod shells and coral chips are also consumed for grit (Jenkins 1979).

At the SDZ, adult rails were fed millet, canary seed, hard-boiled eggs, bread and milk, boiled rice, small diced fruit, and ground horsemeat; and mealworms, crickets, cockroaches, and Drosophila were fed several times daily to the chicks (K. C. Lint, pers. comm.). The basic diet used at CRC and the Bronx Zoo is similar (Table 2), although mealworms, corngrubs and crushed oystershell are being provided ad lib. At the GDAWR facility, captive rails are fed a gruel mixture containing hard-boiled eggs, high protein dog food, ground dry dog food, powdered gelatin, insects, wheatgerm, seedless raisins, corn oil, and calcium and vitamin supplements (R.E. Beck, pers. comm.).

At all 3 captive breeding facilities, eggs have been artificially incubated (98-99°F dry bulb, 85-90% wet bulb humidity) and hatched, and the chicks successfully hand-reared. Incubation has been 20-21 days. Young chicks readily accept food that is offered to them using a forceps or a red-tipped, slender dowel similar to that used for feeding young cranes (Kepler 1978). At CRC the single chick that was hand-reared was fed a mixture of flight conditioner crumbles, canned dog food, boiled egg yolk,and chopped kale, as well as live mealworms, and was feeding on its own after the third day.

Most adult breeding pairs have proven to be excellent parents, and the majority of chicks raised in captivity thus far have been parent-reared. Food items are regularly offered to the rapidly-growing chicks by the parents until the chicks are 7-10 days old. Mealworms, corngrubs, hard-boiled egg, and canned dog food seem to be especially preferred during this period.

Sex Determination

Guam rails develop typically adult plumage and adult eye color when 4-5 months old, and birds in captivity have bred for the first time at 6 months of age. Although males tend to be slightly larger than females (Riply 1977, Jenkins 1979), sexing on the basis of body weight and external measurements has proven difficult. Statistically significant differences in tarsus length, culmen length, bill length, and wing length have been found between males and females at CRC (Table 3), yet these results must be considered preliminary at this time because sample sizes are small, and because sample ranges are smaller than previously published information (Ripley 1977, Jenkins 1979). Hopefully, as sample sizes are increased in the future, discriminant analysis (Hanners and Patton 1985) can be used to accurately sex birds without resorting to laparotomy.

Accurate sexing of birds thus far has been accomplishes via laparotomy. Eighteen rails have been sexed in this manner at CRC to date, and no adverse effects or mortalities have resulted. Individuals undergoing laparotomy were anesthetized using 0.5 mg of Valium followed 10 minutes later by 15 mg of Ketamine. Once the birds were anesthetized, a small incision was made in the caudal-public area or the sternal-costal knotch using standard sterile surgical procedures. Thereafter, direct observation of the gonads was accomplished by the insertion of a fiber optic laparoscope. Following sex determination, the incision was sutured closed, a prophylactic antibiotic was administered, and the bird was returned to a small darkened box for recovery. Birds were only returned to their normal enclosures after they were fully recovered. Several rails have been sexed via laparoscopy at 5-6 months of age, and we are now trying to determine if sexing can be accomplished at even younger ages in order to facilitate the earliest possible pairing and reproduction in the captive flock.

Discussion

Original plans for establishing a captive population of Guam rails called for the capture of at least 20 individuals. Unfortunately, the wild population declined so dramatically that by June 1985 GDAWR personnel could only locate 1-2 remaining birds and trapping efforts had to be be suspended. The captive population presents consists of 52 birds, including 10 founders. Obviously, if genetic problems are to be avoided, the captive population needs to be increased as rapidly as possible and carefully managed.

Fortunately, rails have proven easy to maintain and breed in captivity. Like their wild counterparts, captive birds breed throughout the year, and become sexually mature at about 6 months of age. Clutches in captivity have ranged from 2-5 eggs, and breeding breeding pairs have recycled and laid additional clutches while still raising 21-35 day old chicks. These basic biological characteristics -- year-round nesting, early sexual maturity, high fecundity -- all favor the long-term success of the present rescue project.

Preliminary estimates suggest that the captive rail population needs to be expanded to about 150 - 180 birds in order to retain 85 - 95 percent of the extant genetic variation over the long term. Although propagation facilities in Guam are currently being expanded, the maintenance of the aforementioned number of rails in captivity will necessarily require increased participation in the rescue project by other zoos. A studbook data base for the rail is now being assembled to insure the proper demographic and genetic management of the entire population.

A number of studies are now underway in Guam to determine whether or not the brown tree snake can be effectively eradicated and/or controlled. Hopefully these investigations will prove successful, and the Guam rail can eventually be reintroduced to its native habitat on Guam. Although reintroduction remains the primary goal of the rescue project, efforts at the present time must be focused on consolidating our gains in captivity.

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Table 1. Post-mortem examination results on captive Guam rails.

Cause of Death	Location			Total
	SDZ[1]	CRC	GDAWR	
Trauma	3	1	1[2]	5
Bacterial infections	4	–	–	4
Drowning	1	–	1	2
Malnutrition	1	–	–	1
Cloacal imapction	–	–	2[3]	2
Unknown/undetermined	1	–	1	2
TOTALS	10	1	5	16

[1] information supplied by M. L. Jones.

[2] injuries apparently self-induced while this male was being held in a small cage during typhoon Vanessa (R. E. Beck, pers. comm.).

[3] both mortalities involved 2-3 day old chicks retrieved from the wild. Both birds were severely dehydrated, and survived several days with hand and tube feeding. A third chick survived (R. E. Beck, pers. comm.).

Table 2. Guam rail diet used at CRC.

	ITEM	AMOUNT
Per Bird:		
	Ground egg (incl. shell)	¼c.
	Chopped Kale	1T.
	Corn grubs	1T.
Per Pen:		
	Grain Mix[1]	1T.
	Soaked monkey biscuit	1
	Soaked dog biscuit	4
	Flight conditioner	1T.
	Bird of prey diet	1T.
	Canned dog food	1T.
	Bread-milk mixture[2]	1T.
	Mealworms/crickets/oystershell	ad. lib.

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[1] Contains: millet, canary seed and pigeon grain

[2] Contains: bread, linatone/wheatgerm/carrot oil mixture, vionate,Projest, honey, evaporated milk, carrot juice,and water.

Table 3. Measurements of male and female Guam rails.[1]

	Females			Males			t
	n	$\overline{X}$ ± SD (range)	CV	n	$\overline{X}$ ± SD (range)	CV	
Tarsus	7	46.7 ± 2.4 (43.0-50.0)	5.1	8	50.8 ± 2.5 (48.0-55.0)	4.7	3.2*
Midtoe	7	43.0 ± 2.8 (38.0-46.1)	6.6	8	44.7 ± 1.6 (42.5-47.0)	3.6	1.4
Culmen Length	7	35.6 ± 1.6 (34.0-38.2)	4.4	8	40.7 ± 1.9 (38.0-43.5)	4.7	4.7*
Bill Length[2]	7	26.2 ± 1.0 (25.0-27.5)	3.8	8	29.8 ± 1.3 (28.0-31.0)	4.3	5.7*
Wing Length	7	123.9 ± 2.3 (121.0-128.0)	1.9	8	130.3 ± 1.3 (128.0-131.0)	1.0	6.4*
Weight[3]	7	233.0 ± 37.4 (200.6-313.4)	16.1	8	252.5 ± 20.9 (212.7-279.78)	8.3	1.2

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[1] Linear measurements in millimeters, weights in grams; significant t-values ($P<0.05$) indicated by asterisk.

[2] Proximal edge of nares to bill tip.

[3] Individuals were weighed 2-5 times each; analysis based on average individual weight.

DEVELOPMENT OF CAPTIVE RAISED ABYSSINIAN GROUND HORNBILLS

by

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Introduction

In 1973, the first successful western hemisphere captive breeding of Abyssinian ground hornbill, Bucorvus abyssinicus, occurred at the San Diego Wild Animal Park (Penny, 1974). Since then, three additional zoos, Boston's Walter D. Stone Memorial Zoo, Abilene Zoological Gardens, and the Dallas Zoo, have successfully reproduced this species, and to present, a total of 31 offspring have been reared at these four institutions. These breedings were significant not solely because reproduction of this species in captivity is uncommon, but because these events offered the opportunity to obtain valuable information on the growth and morphological and behavioral development of young, and also enabled the facilities to employ several methods of rearing the offspring. The zoos did not miss the opportunity to record this information, and a wealth of data has been accumulated. The purpose of this paper is not to formally present this data, but to characterize the development of young ground hornbills, describe a method of partial hand-rearing we call "shared-rearing" and to compare the growth of individuals reared by each of three methods: parent-rearing, hand-rearing, and shared-rearing. Though not truly a collaborative effort, I have drawn heavily upon information provided to me by staff of the above mentioned zoos. This paper then, is preliminary to a more comprehensive analysis of growth in hornbill species.

Nesting Behavior

The ground hornbills are two African species, who as their name implies, are terrestrial in their habits. They are gawky in appearance, but interesting to watch as small groups forage methodically through low vegetation in search of small animal prey, such as lizards and insects. In captivity they are rather docile and tolerant of disturbance, and are easily maintained in rather small enclosures. Unlike the arboreal hornbills, the female is not sealed into a nest cavity, but rather utilizes a subterranean burrow or natural cavity close to the ground.

Good descriptions of the courtship and nesting behavior of Abyssinican ground hornbills in captivity were given by Penny, and by Higgins (1981). Based upon their accounts and the observations recorded during several nestings at Dallas, we can portray a sequence of behavior leading to nesting. I list them in the order in which they typically first occur.

Calling - a "booming" call, first emitted by the male, is answered less intensely by the female. Booming occurs infrequently throughout the year, but intensifies just prior to nesting.

Nestsite Selection - this searching behavior is characterized by digging and probing with the beak. Both partners participate.

Fencing, or Sparring - the male and female circle, then face each other and duel with their beaks. This is apparently a primary courtship display.

Offering of Food - one partner offers single food items to its mate. Most often the male offers and the female receives.

Litter Gathering - the female lines the nest with small leaves and other vegetation that is gathered by the male and presented to her.

Copulation - although not often observed, copulation has been seen to occur both on the ground and upon a low perch.

We have observed that once the female retires to the nest chamber, lays her eggs and begins incubating she leaves only for brief periods, usually to feed. The male continues to offer her food items and nest litter. At Dallas, the male is tolerant of human intrusion, but attempts to repel birds that reside in adjacent cages.

Usually two eggs are laid, several days apart, and since incubation begins shortly after the first egg is laid, the first chick may be as much as a week older than the second. Normally only one survives. However, in several instances now, clutchmates hatched in captivity have both survived and thrived. The method used to accomplish this is a major point of this presentation.

Growth and Development

Known incubation periods for 14 captive hatched Abyssinian ground hornbills averaged 37.8 days. The hatching process, from first pip to emergence took as long as 52 hours, but more typically was less than 48 hours in duration. The naked chick has pinkish skin, and barely discernable feather tracts, most noticeable on the crown and lower back. The eyes are closed. The beak is dark grey to black, tipped with cream, and the lower mandible is about 3 mm longer than the upper. Hatching weight for 16 individuals averaged 69.7 gms. Weights were recorded frequently for many of the chicks, at least through seven weeks of age. Using this body of data, a characteristic growth rate curve has been generated. (Fig. 1).

Higgings observed three growth phases. We saw a continuum of development that was consistent with his generalization. Within the first seven days, all skin except the gular pouch became dark blue to purple, eyes began to open, and feather tracts were easily visible beneath the skin. Though most chicks lost a fraction of body weight initially, rapid and accelerating increase in weight began. At 10 days, eyes were partially open and some feather emergence was noted. At 14 days feathers clearly erupted. Feather growth from this time onward was rapid. At 21 days eyes were fully open, and the upper mandible had grown to meet the protruding lower beak. By the end of four weeks the "eyelashes" were prominent, contour feathers of 5 mm to 10 mm length covered the body evenly, and the birds were able to grip well. From age 4 to 6 weeks rapid feather growth occurred, and the weight gain became constant at 75 g/day. Not until the end of the sixth week did the rate of growth diminish. Chicks typically exceeded adult weight before emerging from the nest chamber at about 8 weeks of age. Birds were capable of limited flight at the time of emergence.

Shared-rearing

In 1981, Dallas Zoo's long-time captive pair of Abyssinian ground hornbills successfully hatched and reared one chick. Cautiously at first, we recorded the chick's progress. Weights and some linear measurements were taken regularly and photographs were made. It was soon apparent that the parents were extremely tolerant of our frequent intrusion, showing no reaction when the chick was removed for short periods. When in 1982, two chicks hatched five days apart, we recognized that if both were left with the parents the younger would likely die. Shortly after we discovered the second chick we removed the first, placed it into an incubator, and began to hand-rear it. As though oblivious to the switch, the parents turned their attention to caring for their second chick. Both chicks thrived and closely paralleled growth patterns exhibited by the 1981 chick, so at the end of one week we employed a technique pioneered at Abilene Zoo the previous year. We replaced the older chick and removed the younger chick. Not surprisingly the parents seemed undisturbed by the exchange and they accepted the considerably larger sibling immediately. Each week we alternated the chicks until both fledged. Both chicks seemed to develop normally and while they were rather tame, neither was overly human oriented. This summer we again used this technique, and the results were similar.

Growth Pattern

Good growth rate data exists now for six birds raised by shared-rearing, four parent-reared birds, and seven hand-reared birds. These values, through seven weeks of age, were averaged and plotted against time to generate a growth curve (Fig. 1), that serves as a model. Three other curves were plotted, representing each of the methods used for raising the young, and these were overlaid upon the model curve (Fig. 2-4). A superficial inspection reveals these facts:

- Regardless of rearing method, chicks weighed close to 2350 g at 5½ weeks.
- Parent-reared birds grew fastest through five and one half weeks, but the rate of growth began to slow earlier.
- Hand-reared birds grew slowest through 5½ weeks but the rate increased throughout this period.
- Birds that were shared-reared, most closely matched the average, or model curve.

Regardless of these differences, we feel that either rearing method approximates normal growth.

Conclusion

We attempted the method of sharing parental duties primarily to ensure survival of both chicks, but we were also concerned about the physical and social development of the youngsters. Two chicks had previously been hand-reared - one at Boston and one at Abilene. Lazarus (unpub. observ.) had reported that "Willie", the male hand-raised at Boston in 1980, had shown "no fear of humans and was somewhat friendly". Believing that imprinting on humans might adversely affect these bird's breeding potential, we chose not to hand-raise either bird. We risked imprinting both siblings, and hoped that neither would show distorted social development. We believe we have been successful. The birds reared in this manner are calm and tolerant of human presence, but remain aloof. "Willie", who was hand-reared has subsequently paired and produced offspring at San Diego Wild Animal Park.

Our picture of physical growth is crude, but with additional weights for the later weeks of development and for adult birds, we can complete the graph and by subjecting it to curve-fitting analysis, we can determine growth constants and begin to better understand growth in this species.

Acknowledgements

I extend my appreciation to the following people for contributing records and manuscripts: Robert Wilson from The Boston Zoos, Mike Higgins from Abilene Zoo, and Mary Lieras and Dave Rimlinger from San Diego Wild Animal Park. I also thank Celia Falzone for compiling, tabulating and graphing all growth data, and Wanda Weaver for typing the manuscript.

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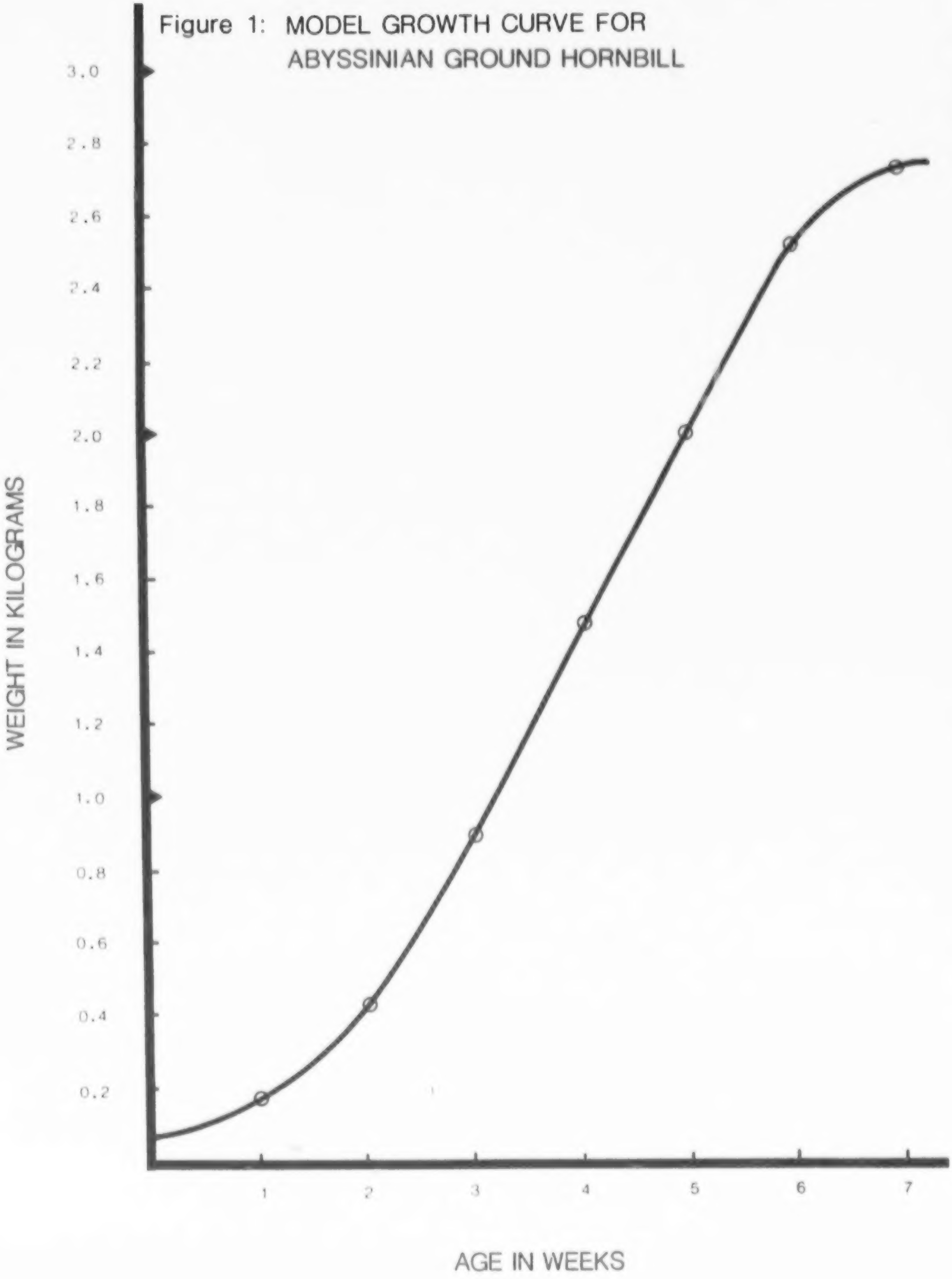

Figure 1: MODEL GROWTH CURVE FOR ABYSSINIAN GROUND HORNBILL

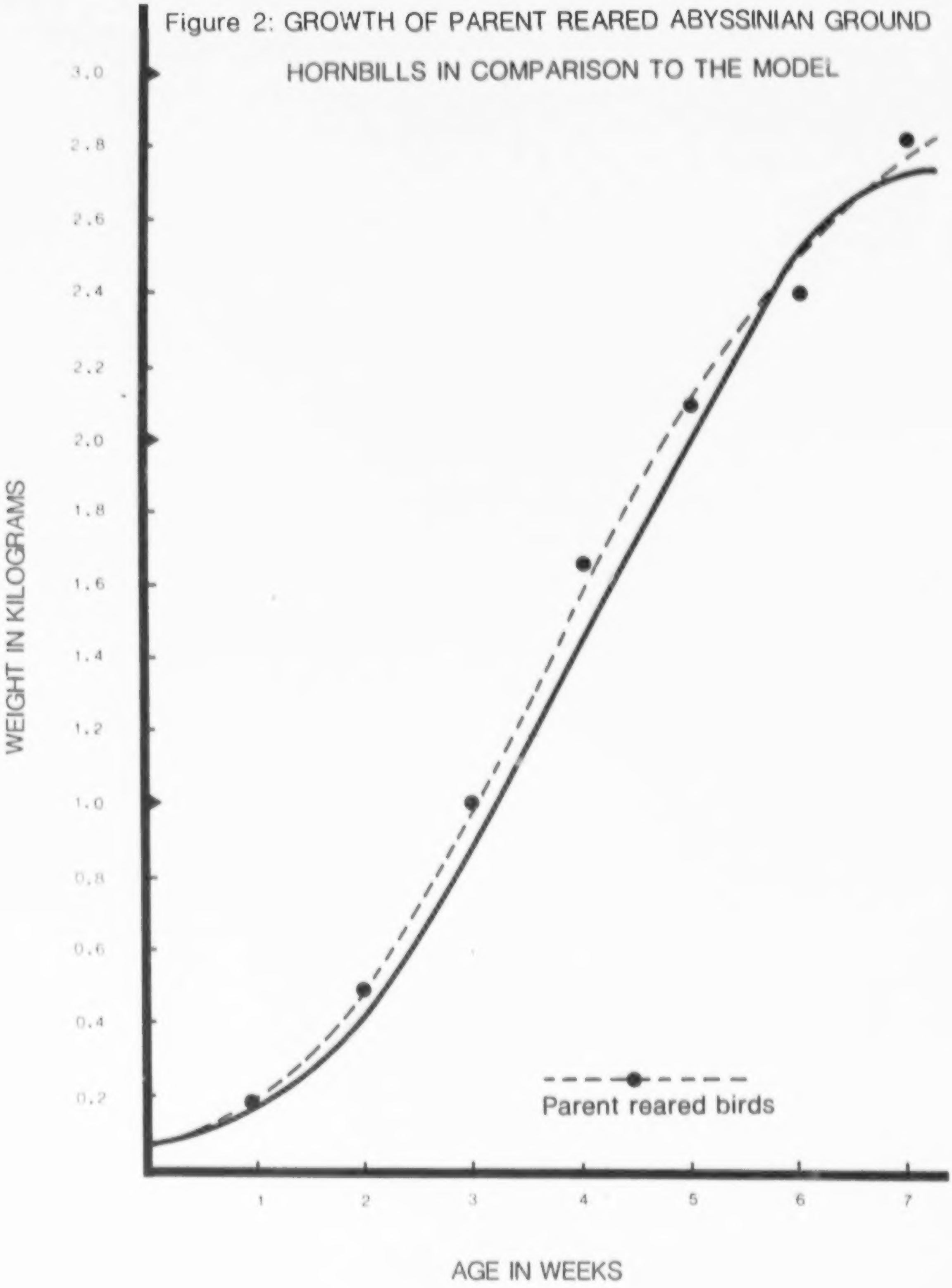

Figure 2: GROWTH OF PARENT REARED ABYSSINIAN GROUND HORNBILLS IN COMPARISON TO THE MODEL

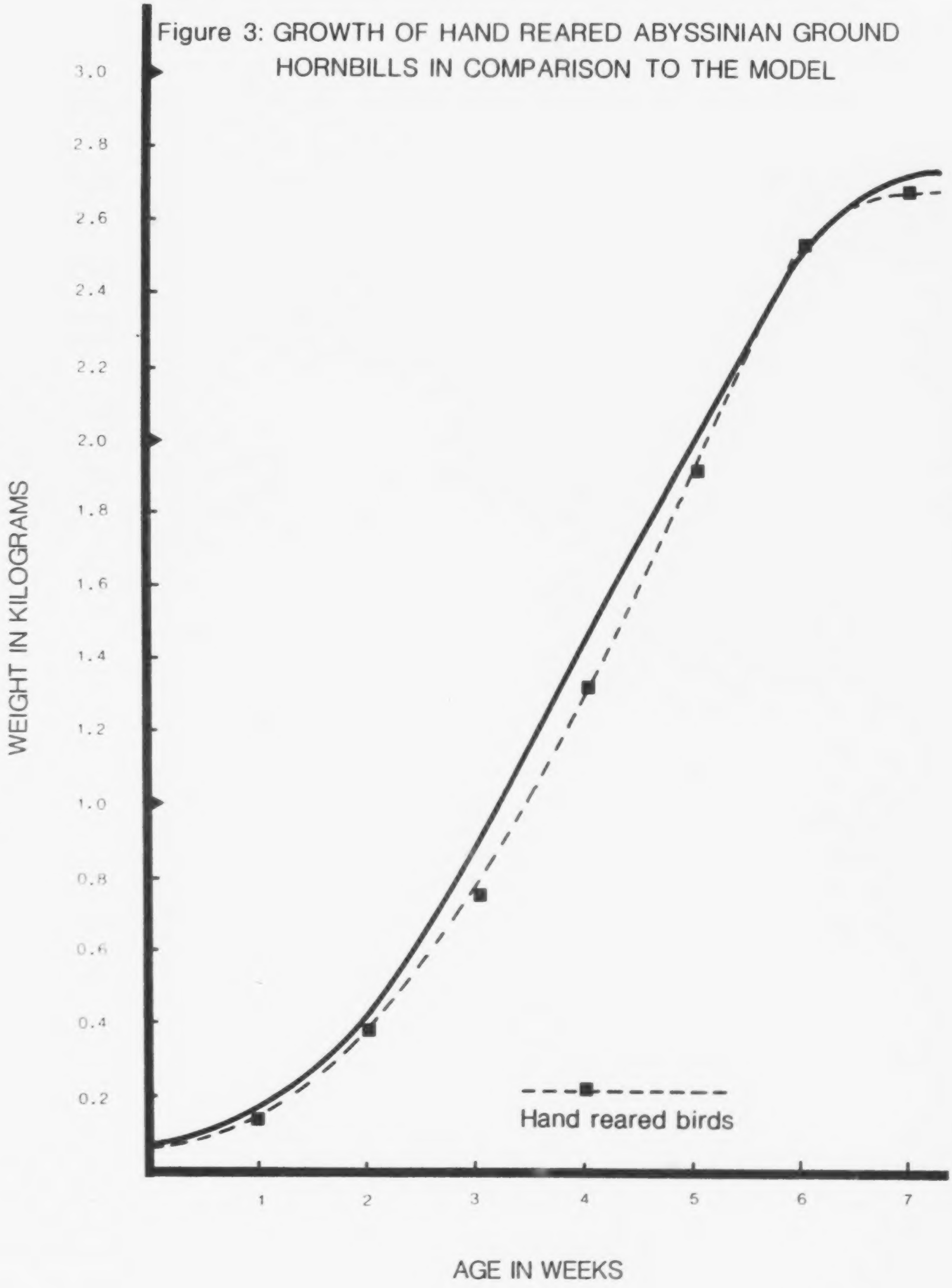

Figure 3: GROWTH OF HAND REARED ABYSSINIAN GROUND HORNBILLS IN COMPARISON TO THE MODEL

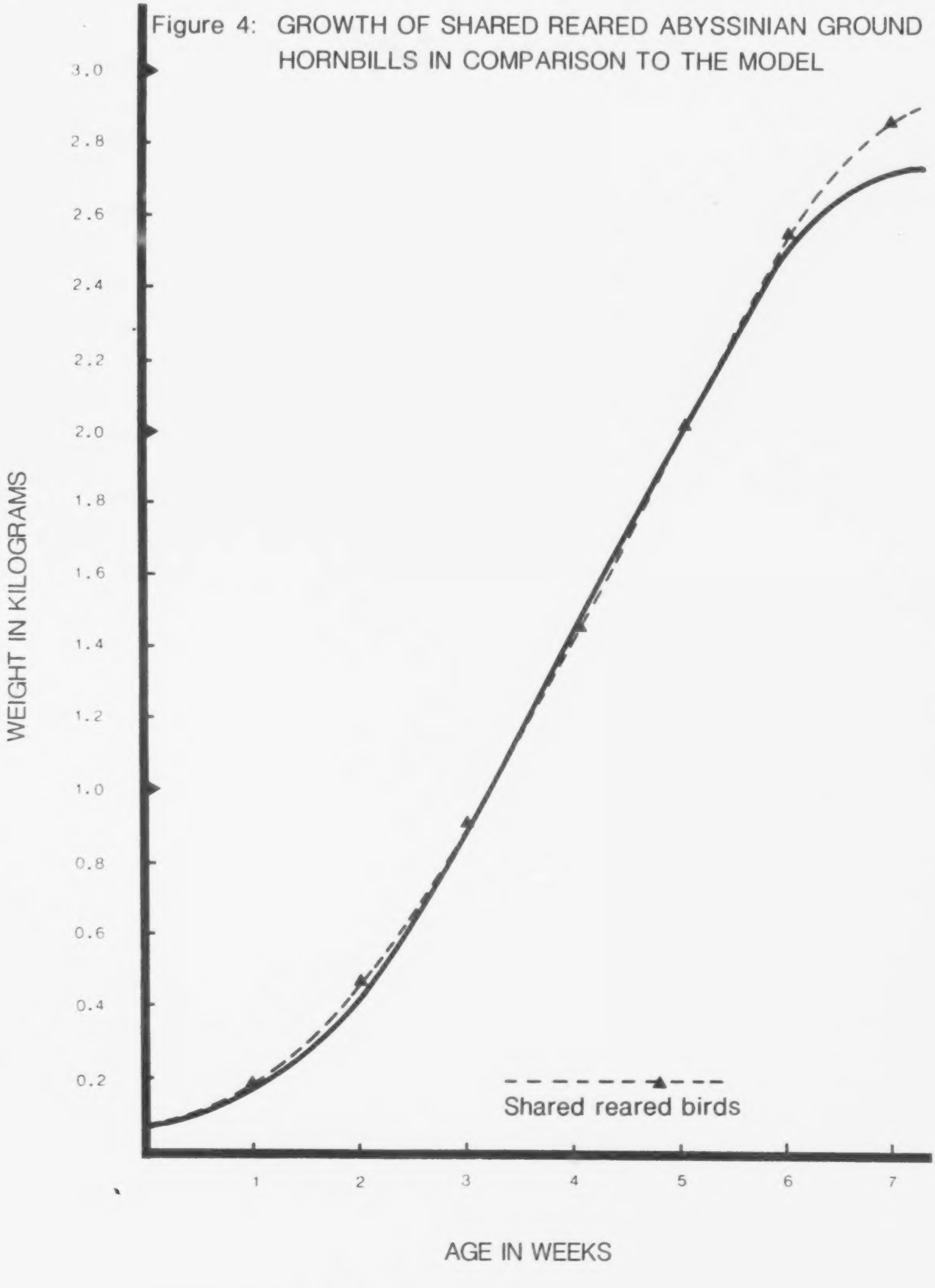

Figure 4: GROWTH OF SHARED REARED ABYSSINIAN GROUND HORNBILLS IN COMPARISON TO THE MODEL

PRELIMINARY RESULTS OF THE SAN FRANCISCO ZOOLOGICAL GARDENS' MAGELLANIC PENGUIN (SPHENISCUS MAGELLANICUS) PROGRAM

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INTRODUCTION

Magellanic penguins (*Spheniscus magellanicus*) are found along the Patagonian coasts and the Falkland Islands (Clements 1981). Though Magellanic penguins are very numerous in the wild, very little is known about their biology (Boswall and MacIver 1975). Additionally, they are rarely seen in zoos (Gailey-Phipps 1978). When a group of 67 Magellanic penguins arrived at the San Francisco Zoo in 1984, we had the opportunity to learn more about this species.

This paper reports on the successful program of care, maintenance, and propagation management developed for a group of wild-caught Magellanic penguins exhibited at the San Francisco Zoo.

METHODS

Exhibit Preparation

The exhibit for the penguins consisted of an outdoor pool, 57 m x 11.4 m x 0.8 m. An island in the center measured 29 m and was 5.8 m at its widest point (Fig. 1). Four raised hills of earth were formed on the island. Their average height was 50.8 cm. Thirty-six pre-formed fiberglass shells were inserted into these hills. This created tunnels, and gave the start and support for burrows the penguins would dig and use as nesting sites. Exposed dirt at the back and bottom of the fiberglass shells allowed the penguins to excavate the burrows (Fig. 2).

Initially, the earth hills were covered with sod, but this deteriorated rapidly and was ultimately replaced with a coating of cement. Also, carpets of astroturf-like artificial grass were placed on the cement hills. Vegetation on the island included two thick plantings of pampas grass (*Cartaderia selbana*) at either end (east and west). This created an effective windbreak. The other prominent plant on the island was the cordyline palm (*Cordyline australis*).

When the pool was filled with water, the average water level was 0.64 m. Water quality tests were performed. The water was determined to be pure (coliform count of less than 2.2 ppm). Haul-outs for the penguins consisted of stacks of cinder blocks.

Penguins' Arrival

On 11 May 1984, 67 Magellanic penguins arrived at the zoo. They had been wild-caught from the coast of Chile. Upon their arrival, a crew of 10 (keepers and veterinary staff) removed the birds from the crates for processing. This included weighing, banding, and taking random blood samples. Weighing was accomplished by placing each bird in a pillowcase and then into a "Sky Kennel®" animal carrier. As each bird was weighed, it was assigned a number and banded with a human, hospital-type, plastic "Identi-A-Band®" which was placed around the base of the flipper. At this time any unusual condition, such as molt, was noted. The birds were re-crated and taken to the exhibit. The crates were opened on the island, and the birds were closely monitored following their release into the exhibit.

Care and Feeding

Two full-time keepers were assigned to the penguins. The feeding of the penguins, which was the bulk of the workload, included the preparation of the fish and the administering of vitamin supplements and other medications. In the beginning the birds were offered whitebait smelt (*Osmerus osmerus*) and Pacific herring (*Clupea pallasii*). The fish were up to 18 cm in length and weighed 50-90 g. The smelt was ultimately phased out. Fish was obtained in frozen blocks and thawed in cold running water; as soon as individual fish were separated and pliable, they were refrigerated. Efforts were made to quickly thaw fish close to feeding time. Thawed fish deteriorates rapidly and buildup of thiaminase may cause serious vitamin deficiencies.

Prior to each meal a certain number of fish were pilled with vitamins or other supplements. Pills or capsules were inserted into the fish through the gills. These "medicated" fish were given to each of the penguins before they were fed plain fish. Two feedings per day were scheduled at 0830 and 1430 hours. For the vitamin supplement regimen, see Table 1.

Twice a week, the penguins were given a dose of ketoconazole in their a.m. fish as a preventative and control for aspergillosis. This was administered as a liquid suspension made by dissolving 200 mg of Nizoral® in sterile water, with two drops of 0.2% hydrocloric acid per tablet to maintain an even dilution while in suspension. Initially the dosage was 5.0 mg ketoconozole (1 Nizoral tablet per 20 ml water); after several weeks this was increased to 10 mg. The liquid suspension was put into the morning medicated fish by filling a #0 gelatin capsule (0.5 cc). This procedure always required two people working in tandem, one to make the capsules and the other to insert them into the fish.

On 17 July 1984, 3.5 mg of Primaquin® was added to each afternoon medicated fish daily, as a prophylaxis for possible avian malaria. In addition, ferrous gluconate tablets (5 g) were added twice a week to the morning medicated fish to minimize anemia. Use of the Primaquin was suspended briefly in January 1985 but resumed shortly thereafter when a pathology report showed possible malaria. Primaquin (and iron) were removed from the daily regimen on 1 August 1985 to avoid hemosiderosis.

Attempts were made to hand feed each of the birds. From the beginning, complete records were kept on the daily food consumption of each bird (Fig. 3). Volunteers assisted at feeding time to record how many fish were eaten by each bird.

Gulls (Larus occidentalis, L. argentatus, and L. californicus) were a serious and frequent problem at the exhibit, especially at feeding time when they stole fish and harassed the penguins. Wire cables were strung over the exhibit to interrupt the gulls' flight patterns and discourage them. During the breeding season, additional wires were added to protect eggs and chicks from gull attacks.

During the breeding season efforts were made to create as little disturbance as possible to nesting birds (Penney 1978). The daily cleaning and hosing of the island was curtailed as nest building began. The pool cleaning schedule did not change.

Care of the Young

Eggs were laid in the 1985 breeding season. All penguin eggs were parent incubated. At the onset of hatching all chicks were checked daily for dehydration by pinching the skin below the keel with the thumb and index finger. Weight gain was also recorded at this time and the birds were examined for alertness and general condition. The condition of the eyes, interior of the mouth, plumage, and respiration rate was noted. Any bird that didn't gain weight in a 24-hour period, exhibited dehydration, unusual behavior, or any medical problem was removed from the island to the hand rearing facility in the zoo hospital.

At this time, birds' wings were affixed with nylon marker ties. Each bird was assigned a specific color code. The color was crayoned onto the marker with permanent, non-toxic felt markers. The wing markers were affixed around the wing at the base. They were tight enough to insure that they couldn't slip off the wing. Bands were checked every morning to insure that they weren't too tight.

After receiving a color-coded band, birds were then entered into the hand rearing program. Birds under one week of age were placed in Thermocare® animal isolettes. The isolettes were furnished with heating pads set on low. The pads covered one third of the floor of each unit. The entire floor of a unit was them covered with Curity brand disposable, absorbent underpads. The temperature of the units was adjusted according to the birds' behaviors. If birds panted or drooped wings, the temperature was lowered. If birds shivered, the temperature was elevated.

Older birds were placed in 1.5 m x 1.5 m x 1.5 m open top units. The walls of the units were comprised of cinder blocks. The cinder block walls were 0.5 m high and covered with astroturf-like matting. The matting was changed four times a day. Three to four birds of similar ages were placed in each unit. Units that contained birds under the age of two to three weeks had one to two heating pads set on medium or low. The heating pads were placed under the matting.

At 45 days of age the birds were taken outside and placed in a wire-covered enclosure. Seventy-five percent of the substrate of the enclosure consisted of grass and the remaining quarter was a cement floor covered with the astroturf-like matting. Up to 13 birds were placed in this unit together.

The birds' ability to swim was tested in a 1.5 m diameter plastic "kiddie pool." Once the birds were shown to be proficient swimmers, they were taken to the penguin exhibit pool and allowed to swim for up to two hours a day, until they reached 60 days of age, at which time they were surplused to the Detroit Zoo.

Diet and Feeding

The diets and feeding regime used to rear the Magellanic penguins were adapted from information given to us by the Baltimore Zoo, Sea World, and Steinhart Aquarium (Hewitt 1985; Stosfknopf and Beall 1980; Todd 1980; Towhee 1985). Feeding behavior was elicited by moving the index and middle finger up and down the bird's beak. Hand reared birds were weighed daily at 0700. During the next 24 hours birds were fed an amount of food that equalled or was less than 10% of their weight. Birds weighing up to 300 g were fed every three hours around the clock. Birds weighing 300-500 g received five to six feedings per day. Birds weighing 500-700 g were fed four times daily, and those weighing between 700-1,000 g were fed three times per day until fledging.

On the first day, the first and second feedings consisted of 1-2 cc of oral electrolyte solution. Feedings three through eight consisted of 50% electrolyte solution and 2-4 g of formula. On day two all eight feedings consisted of 25% electrolyte solution and 4-7 g of formula. On day three all eight feedings consisted of straight formula. On days five and six, if the bird weighed 200 g, it was given fish filleted in small pieces one or two times a day in the a.m. and in the p.m. The fish totaled 3-5 g. The formula was continued except that 1-2 g of electrolyte solution was substituted for the formula. If the bird weighed 250 g, the fish fillet was given every other feeding along with up to 3 g electrolyte solution substitued for the formula. If the bird weighed 300 g, a total of 30 g of fish per feeding was given along with up to 5 g of electrolyte solution substituted for the formula. If the bird weighed 400 g, a total of up to 15 g of fish per feeding along with the formula was given. If the bird weighed 500 g it was given half formula and half fish. If the bird weighed 700 g it was given 35 g of formula, 10-15 g of water, and as much fish as it wanted. When the bird reached 50-60 days of age, and fledged, the formula was discontinued and the bird was transferred to the adult diet and supplement program.

We provided supplements for the hand reared birds: When the bird weighed 500 g, 50 mg of B_1 B.I.D. was administered; when the bird weighed 1,000 g, 100 mg of B_1 B.I.D., ½ Sea Tab B.I.D., and 100 IU vitamin E was given.

The penguin "milkshake" tubing diet was made fresh every 24 hours by combining: 330 g herring, 330 g krill or brine shrimp, 250 ml half and half dairy cream, 250 ml electrolyte solution, 1 vitamin packet, and three 500 mg capsules IU vitamin E. The penguin milkshake was administered with a feeding catheter tube and a 60 cc catheter tip syringe. Each bird had its own individually labeled feeding catheter. Cleaning of syringes and catheters was a four step process that involved rinsing, washing, cleaning in an ultrasonic cleaning unit, and a final rinse.

Food preparation was the most time consuming facet of the project. The following steps can be done in advance of hatching to save time. At the onset of egglaying, herring, krill, and all necessary dietary supplements were purchased. It should be noted that in some parts of the country, krill suppliers require an order to be placed one year in advance of actual delivery. The herring and krill were weighed out into 330 gm units and bagged in plastic zip-lock baggies. Care was taken to insure that frozen food didn't defrost during this process. Small amounts were removed from the freezer for this processing and placed on frozen "igloo-ice-packets" when they were being handled. All pre-weighed baggies were labeled with the date and weight before going back to the freezer (Stosfknopf and Beall 1980). Vitamin packets were prepared once a week for the penguin "milkshakes." Each packet was based on a shake that would consist of 330 g of herring and 330 g of krill.

The vitamin packets consisted of: 1.5 Sea Tabs, 3/8 tsp. predigested protein, 375 mg vitamin B_1, 9 Dical-Caps (dicalcium phosphate) tablets, 6 Brewer's yeast tablets (7.5 g), and 3 lactinex tablets. The above tablets were pulverized and placed in dated ziplock baggies which were refrigerated.

Measurements

Once a week specific morphological characteristics were measured (Figs. 4-8). We measured total body length, from tip of the bill to the base of the tail. The left foot was measured from the distal end of the third toe along the bottom of the foot to the dorsal end of the first metatarsal. The left wing was measured from the underside of the most proximal point to its distal end. The maxilla was measured along the median plane from base to tip. The plumage was examined as well. Changes in plumage were noted as the birds went from the first to second coats of down to the juvenile plumage. The birds were also weighed. Birds were measured with a compass and ruler. They were weighed with an Ohaus triple beam balance.

DISCUSSION AND RESULTS

Feeding Procedures For Adults on Exhibit

Upon arrival at the San Francisco Zoo, the adult penguins appeared in good health. Weight range was from 3.4 kg to 5.2 kg, with a mean weight of 4.0 kg.

It was our intent to encourage individual hand-feeding. The purpose of this was to have the opportunity to monitor each bird's overall condition on a regular basis, to create positive interaction with the keepers, and to maintain accurate records on food consumption. Fish was delivered directly into the bird's mouth by a short toss.

Several factors appeared to play a role in appetite and food consumption. These included weather, stress, quality of fish, presence of gulls, and seasonal factors such as molting or breeding. Feed totals were usually low in hot weather (Stosfknopf and Beall 1980). Stress was a factor in food consumption in that the penguins would avoid any human contact or approach for a time after they had been handled for rebanding, weighing, or medical purposes. Quality of fish played a major role in the penguins' food consumption. Only fish that were firm, intact, and of the proper size were eaten. When choice herring was not available, feed totals dropped. On days when there was a heavy inundation of gulls at the exhibit, feeding totals were often low. The gulls not only stole fish, but often attacked penguins. Many penguins were so intimidated that they avoided feeding altogether.

The two most significant factors in overall appetite appeared to be the molting season and breeding season. Molting was preceded by a dramatic increase in appetite and food intake. Penguins ate three to four times their normal amount of food. Once the actual molt began, appetites dropped off. We still encouraged the birds to eat even though they would not be doing so in the wild (molting birds do not swim and therefore do not eat). We elected to keep the birds as well fed as possible to avoid their becoming weakened. During nesting and breeding seasons, birds went off feed for long periods of time. The longest known fast was 25 dyas for a nesting female. There weren't any obvious adverse effects, other than minor weight loss.

Reproductive Behavior

We were not certain of our male-female ratio until the birds began pairing up. The first evidence of pairing in the colony was on 14 July 1984. Two birds were observed spending time together, singing duets, and defending a territory. Eight days later, there were four pairs establishing territories at burrows. The following week the first pair was observed attempting to copulate. True breeding (mating and production of eggs) did not occur until spring of 1985. No noteworthy breeding activity other than the occupation of burrows, and some nest building occurred during the fall and winter of 1984-85.

On occasion we observed birds digging in burrows. The pre-formed fiberglass shells created tunnels that were 61 cm deep. The penguins would stand facing these tunnels, balance on one foot, and scrape dirt backwards out of the burrow with the other foot. Beaks were also used for digging. During the 1985 breeding season, most burrows were dug large enough to accommodate both parent birds, with room to turn around. (Later, when young chicks were close to fledging, some parents dug the burrows deeper, thwarting keepers' efforts to pull, examine, or feed chicks. One burrow was excavated to a depth of 12.2 m. Some modifications are being considered to prevent the birds from digging so deep.)

Early, non-productive nest building of the established pairs continued into January 1985. At the end of January, appetites dropped. Many of the birds' feed totals did not improve and after several days we believed this was an indication of the beginning of breeding season. In the wild, when the birds come to shore to build nests, breed, and raise young, they do not swim or eat for extended periods. Relatively low feed totals continued through January, February, and March, as more pairs were established and began building nests. By mid-March, many pairs were in burrows all day and they did not come out to eat.

In order to avoid disturbing the nesting birds, the daily routine of cleaning the island was curtailed. Keepers went onto the island only to feed, to check nests as necessary, and to supply more nesting material (Penney 1978). We brought them additional leaves and twigs as they exhausted the supply of those found on the exhibit; these were quickly used. After 20 March 1985, when copulation was observed, all nests were checked daily for eggs.

The first egg was discovered on 3 April 1985. Interestingly, this was to be the only nest that produced a single egg clutch; all others contained two-egg clutches. Altogether, all but eight penguins formed nesting pairs and produced eggs: 42 birds built 21 nests, and laid 41 eggs. The last egg was laid on 3 May 1985 (Table 2).

Gulls were a persistent problem and we feared they might try to take eggs or chicks. Transparent fishing lines were strung about the exhibit in an effort to keep them out. Gaps did exist and some gulls did drop down and enter the area, but the lines greatly reduced the number of gulls present. No eggs or chicks were lost to gulls.

Before the eggs were due to hatch, measures were taken to prevent young chicks from accidentally falling into the pool. A physical barrier 15.2 cm high was put around the perimeter of the island. This may not have been necessary, as there was only one instance of a young chick out of the nest at an age too early to swim.

The projected hatch date for the first egg was 11-15 May 1985. During the last few days of incubation, males piled more nesting material at the burrow openings; females usually remained in the nest incubating the eggs as the due date approached. (Throughout incubation, males and females shared incubation duties). On the 15th of May, we found the first chick which hatched after a 39 day incubation period. The chick was almost dry, and was active and alert.

Hatchings continued for the next four weeks. Chicks in nests were examined daily to be certain that they were active and being cared for. Parents were observed feeding young in the nest. This began with chicks soliciting for food by cheeping incessantly, raising up, and tapping their head and body against parents. After a few moments, parents responded with a burping motion, bent over, opened their mouths, and the chicks consumed the regurgitated food. After a 5-10 second pause, the solicitations were repeated, up to 20 times, until chicks were satiated.

As second chicks appeared in nests, we began weighing birds to insure that both brood mates were developing properly. In most cases, in order to handle the chicks, it was necessary for keepers to take parent birds out of the burrows. If the chicks were less than three weeks old we felt it necessary to hold onto the parents in order to return them to the nest after the chicks were returned. We were concerned that they would flee and abandon their babies. Care was taken to avoid injury when handling adult penguins. Keepers wore heavy leather gloves and firmly grasped the beak in a closed position. One hand was used to secure the head and beak, while the other hand and arm held the bird's body. The flippers were held against the bird's sides to restrain them from giving their powerful repeated blows. Wearing protective glasses or goggles was encouraged.

The birds had been known to strike upwards toward the face. The method of handling and restraint of adults was the same used when rebanding or holding for physical examination. As chicks reached the age when their parents left them unattended, we no longer felt it necessary to hold and return a parent to the nest after examining the chicks. Once the chicks were removed from the nest, we checked to insure that they weren't dehydrated, thin, losing weight, or exhibiting medical problems. Any questionable youngsters were removed from the exhibit for hand rearing.

Comparison of Parent Reared to Hand Reared Individuals

Very little is known about managing the Magellanic penguin in captivity. Because some chicks had to be hand reared, a comparison of the physical development between parent and hand reared penguins was done. This allowed us to assess the hand rearing program in terms of successfully fledged parent reared birds. It was also undertaken to collect baseline information on penguin development looked at under the two different conditions. We hope the preliminary information presented in Figs. 4 through 8 will be helpful to other institutions involved in rearing this species of penguin. It should be noted that 13 birds were involved in the hand rearing program and 11 chicks were reared by their parents.

Initial analysis of the data, comparing growth rates of the maxilla, left wing and foot, total body length and weight gain clearly indicates that parent reared birds develop faster than hand reared individuals (Figs. 4-8). Plumage changes were also compared. Feather growth was slightly accelerated in parent reared individuals.

As described by Van Tyne and Berger (1976), two successive coats of nestling down occur in penguins. Parent reared youngsters completely lost their first coat of down between the second and third week of life and hand reared birds lost their first down by the end of the third week. Juvenile plumage was attained by parent reared birds by the end of week seven. The hand reared birds were fully feathered with juvenile plumage during week eight.

We don't believe the quantity of intake was the cause of the lag in development of hand reared individuals. We felt that their food consumption throughout the course of the project was at the highest quantity they could handle. In fact, a few of the birds in the hand rearing program showed signs of stress from overeating. They panted and became lethargic. By comparing their ages and weights to those of the hand reared Magellanic penguins at Sea World (Towhee 1985) it was evident that their overeating and accelerated weight gain was the cause of their apparent physical distress.

As is seen in Figs. 4-8, the development of the hand reared birds starts to parallel that of the parent reared birds. Had we not had to surplus half the babies and had the study been able to continue for another two weeks, we may have seen the hand reared birds attain parent raised proportions.

Morbidities and Mortalities

In our first year, prior to the 1985 breeding season, we suffered six mortalities out of our total population of penguins. Five of the deaths were related to aspergillosis; the sixth involved possible malaria. In every case, anorexia, or low feed totals over a period of time was always the first symptom of illness. One penguin was lost in the hand rearing program at 42 days of age. The cause of death was aspergillosis. Two chicks were found dead in their burrows. Their ages were one and four days. Cause of these two deaths could not be determined.

CONCLUSION

We were encouraged by the breeding success of our colony of Magellanic penguins. A total of 24 chicks fledged; 11 were parent reared and 13 were successfully hand reared. We feel that this can be, at least in part, attributed to the design of the exhibit and the hand feeding program which insured all penguins receive adequate food, dietary supplements, and preventive medication. We also feel that monitoring the hatchlings in the exhibit allowed us to manage them in a way that decreased potential losses and increased our recruitment rate for the 1985 breeding season.

ACKNOWLEDGEMENTS

We are grateful to Dr. Craig Machado and his staff for assisting us in every way with setting up the adult care and hand rearing programs and for assigning three rooms in the zoo hospital to the hand rearing program. We also thank staff members Lesley Salmans, Ann Sheldon, and Leslee Avery-Beausoleil and the zoo volunteers for their extremely dedicated day to day care of the baby birds during the 1985 breeding season. We thank Steve Marks for setting up the data collection system and for developing all necessary record-keeping forms.

We would like to express our sincere appreciation to the avian propagation staffs of Sea World, Baltimore Zoo, and the California Academy of Sciences for their technical assistance. And finally a very special thank you goes to John Stokes for his enduring assistance with the audio-visual data collection component for this program.

PRODUCTS MENTIONED IN THE TEXT

Curity brand disposable absorbent pads: The Kendall Company, Consumer Products, Boston, MA. 02101.

Lactinex tablets (Lactobacillus acidophilus): Hynson, Westcott and Dunning, Div. of Becton Dickinson and Company.

Nizoral 200 mg (Ketoconazole tablets): Janssen Pharmaecutical, NJ. 08854.

Panduit brand nylon marker ties: Panduit Corp., Tilney Park, IL. 60477.

Pedialyte brand oral electrolyte maintenance solution: Ross Co., Columbus, OH. 43215.

Primaquine phosphate tablets: Winthrop-Breon Laboratories, New York, NY. 10016.

Sea Tabs: Pacific Research Laboratories, INc., PO Box 1877, El Cajon, CA. 92022.

Thermo Care Isolette: Thermo Care, Inc., PO Box YY, Incline, NV. 89450.

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Van Tyne, J.; Berger, A.J. Fundamentals of ornithology. Second edition, New York: John Wiley and Sons; 1976.

A.M. FEEDING	
Daily	1 Seatab 1 Di Cal Cap (Dicalcium phosphate) 1 B_1 250 mg
Add Sunday	1 Ferrous gluconate 5 grain*
Tuesday	10 mg ketoconazole
Wednesday	1 Ferrous gluconate 5 grain*
Saturday	10 mg ketoconazole
P.M. FEEDING	
Daily	1 Brewer's yeast 7½ grain 1 Cod liver oil capsule (1250 I.U. vitamin A 135 I.U. vitamin D) 1 Thermotab salt tablet 7 grain** ¼ Primaquin tablet (3.5 mg)*
Add Tuesday	1 vitamin E 600 I.U.
Thursday	1 vitamin C 500 mg

* omitted as of 1 August 1985

** as the birds were kept in freshwater

Table 1 Penguin supplement schedule

PARENTS ♂ ♀	LAY DATE (EGG FOUND)	HATCH DATE (CHICK FOUND)	INCUBATION	COMMENTS
61 & 50	6 April	15 May	39 days	Reared by parents through fledging
25 & 56	13 April	16 May	unknown	Reared by parents through fledging
61 & 50	9 April	17 May	38 days	Pulled at 10 days for hand-rearing
25 & 56	27 April	17 May	unknown	Reared by parents through fledging
67 & 57	8 April	17 May	39 days	Reared by parents through fledging
40 & 55	10 April	19 May	39 days	Reared by parents through fledging
63 & 8	9 April	19 May	40 days	Reared by parents through fledging
59 & 15	14 April	19 May	35 days	Out of nest at 2 days; hand-reared*
14 & 36	8 April	19 May	41 days	Reared by parents through fledging
59 & 15	20 April	20 May	unknown	Found dead in nest 25 May
67 & 57	15 April	20 May	35 days	Pulled at 14 days for hand-rearing
6 & 1	14 April	21 May	37 days	Reared by parents through fledging
40 & 55	13 April	22 May	39 days	Pulled at 5 days for hand-rearing
14 & 36	13 April	22 May	39 days	Pulled at 5 days for hand-rearing
35 & 2	13 April	22 May	39 days	Pulled at 8 days for hand-rearing
17 & 54	13 April	22 May	39 days	Pulled at 25 days for hand-rearing**
63 & 8	20 April	22 May	unknown	Pulled at 5 days for hand-rearing
6 & 1	17 April	24 May	37 days	Pulled at 3 days for hand-rearing
17 & 54	16 April	25 May	39 days	Pulled at 4 days for hand-rearing
28 & 10	16 April	26 May	40 days	Reared by parents through fledging
27 & 29	13 April	27 May	44 days	Reared by parents through fledging
28 & 10	20 April	29 May	39 days	Found dead in nest 30 May
27 & 29	18 April	29 May	41 days	Pulled at 26 days for hand-rearing
64 & 18	20 April	30 May	40 days	Pulled at 1 day for hand-rearing
9 & 39	20 April	31 May	41 days	Pulled at 2 days for hand-rearing
20 & 19	23 April	6 June***	unknown	Reared by parents through fledging
52 & 49	27 April	11 June	45 days	Pulled at 2 days for hand-rearing

* Died at 42 days

** Parent-reared until mother too ill to care for young

*** Appeared at least 2 days old when found

Table 2 Penguin hatch record - 1985 breeding season

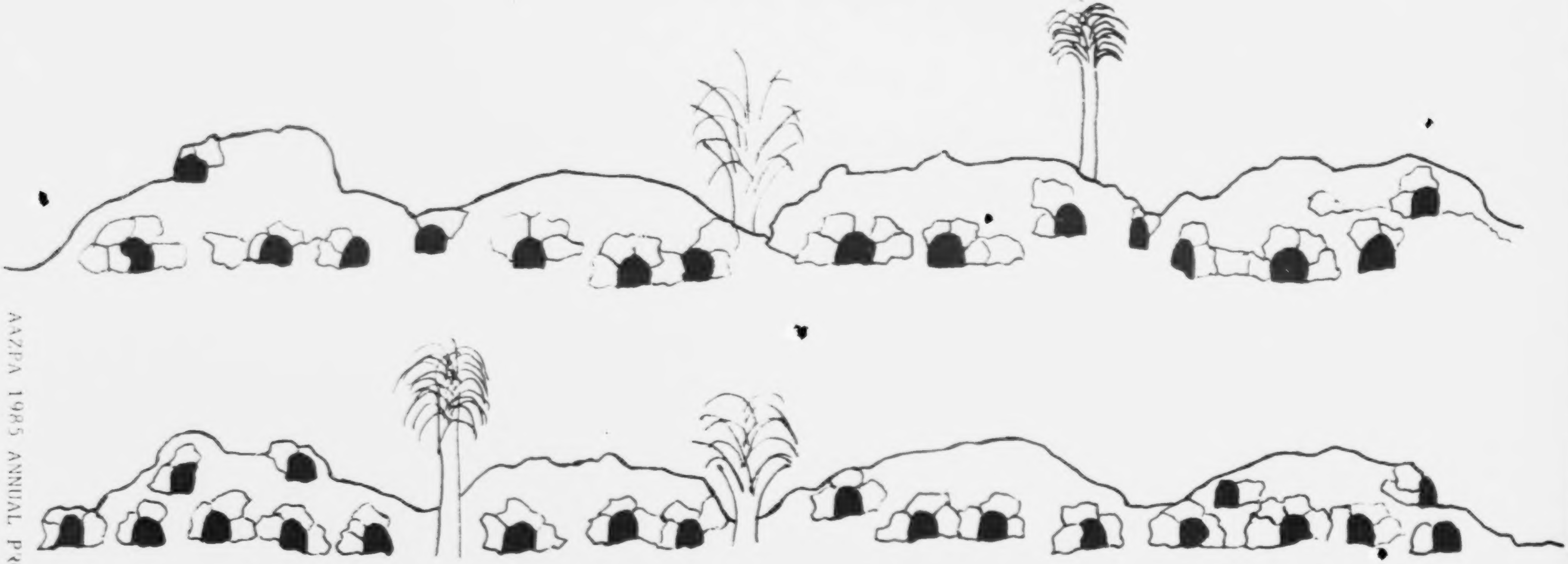


Fig. 1 Map of island showing burrow locations, south side above, north side below.

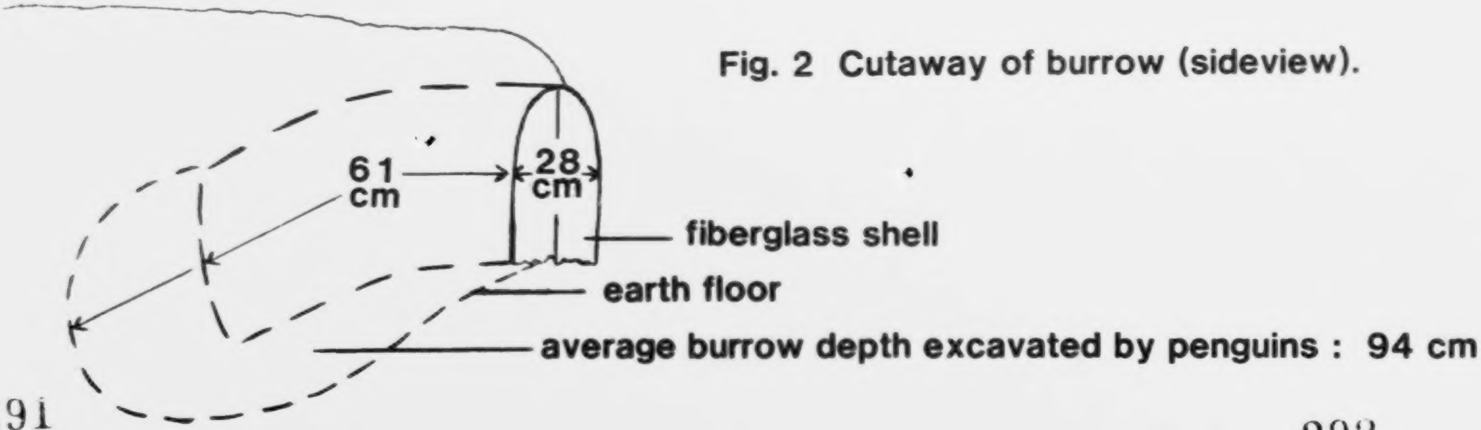

61 cm
28 cm
fiberglass shell
earth floor
average burrow depth excavated by penguins : 94 cm

Fig. 2 Cutaway of burrow (sideview).

	A.M.		P.M.			A.M.		P.M.	
	Rx	Plain	Rx	Plain		Rx	Plain	Rx	Plain
1.					20.				
2.					21.				
3.					22.				
4.					23.				
5.					24.				
6.					25.				
7.					26.				
8.					27.				
9.					28.				
10.					29.				
11.					30.				
12.					31.				
13.					32.				
14.					33.				
15.					34.				
16.					36.				
17.					37.				
18.					38.				
19.					39.				

Date:____________________________

Fig. 3 Daily feed score sheet

Fig. 4 x̄ growth – total body length

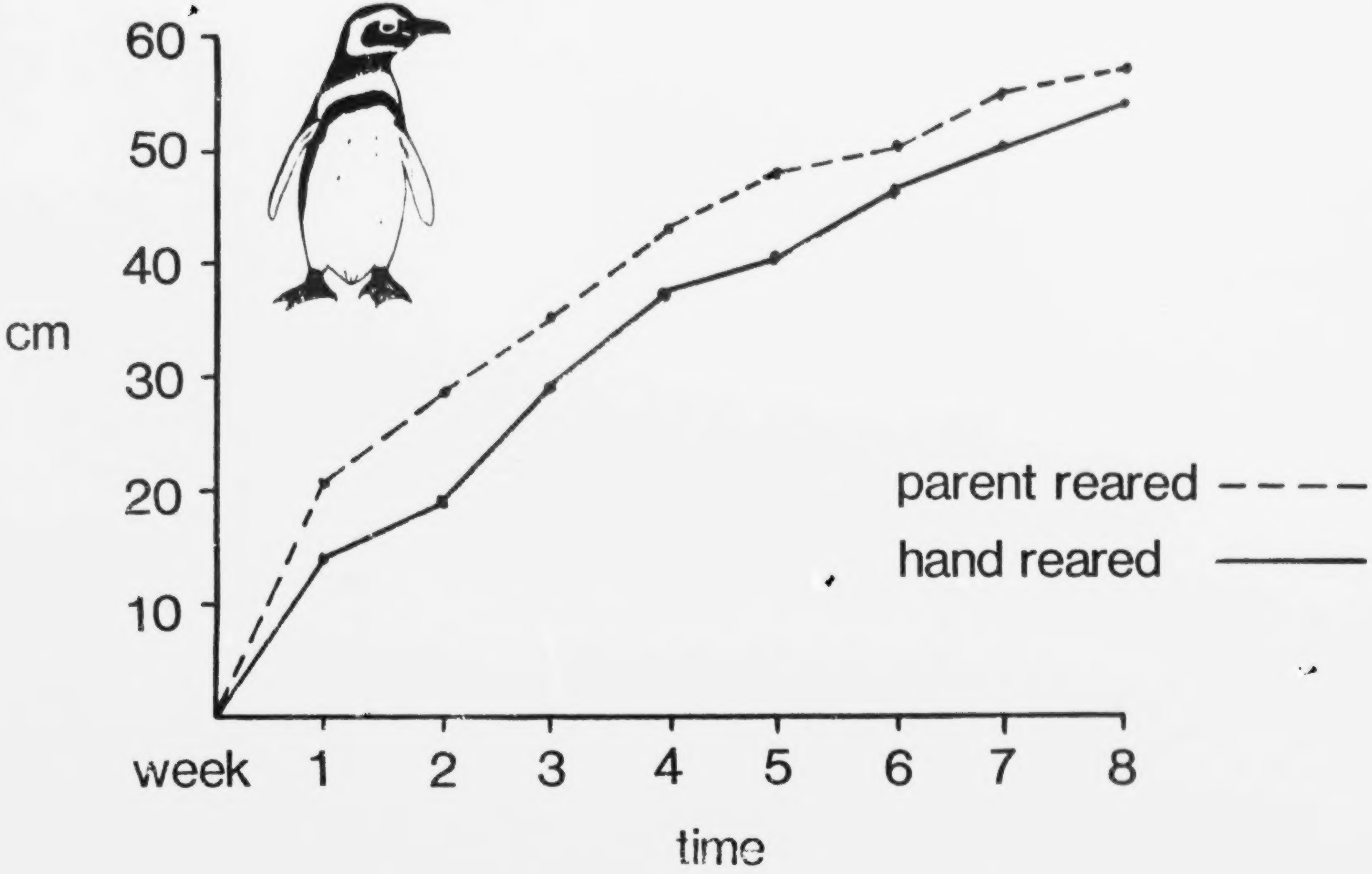


Fig. 5 x̄ growth – maxilla

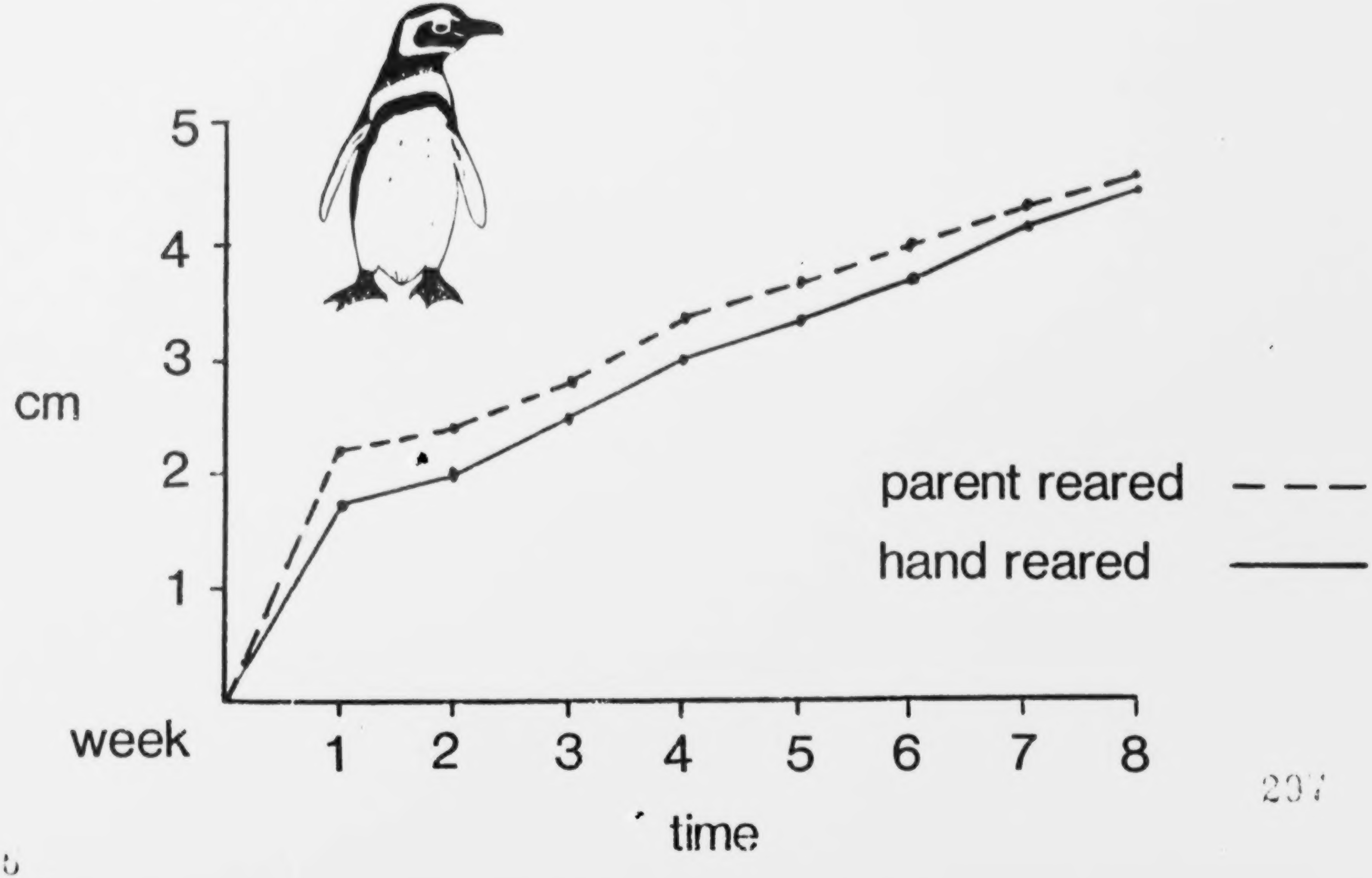


Fig. 6 $\bar{x}$ growth – left wing

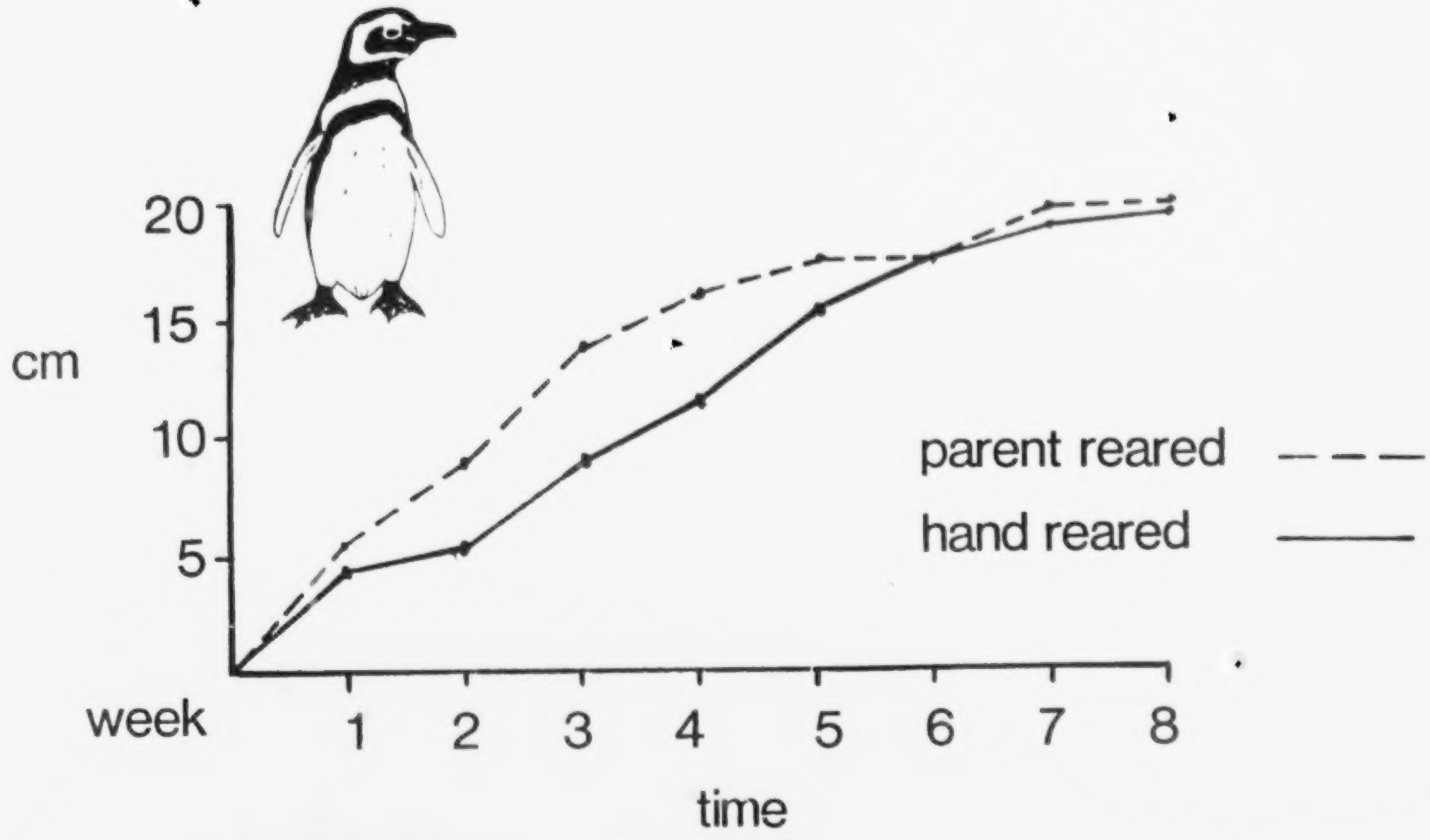
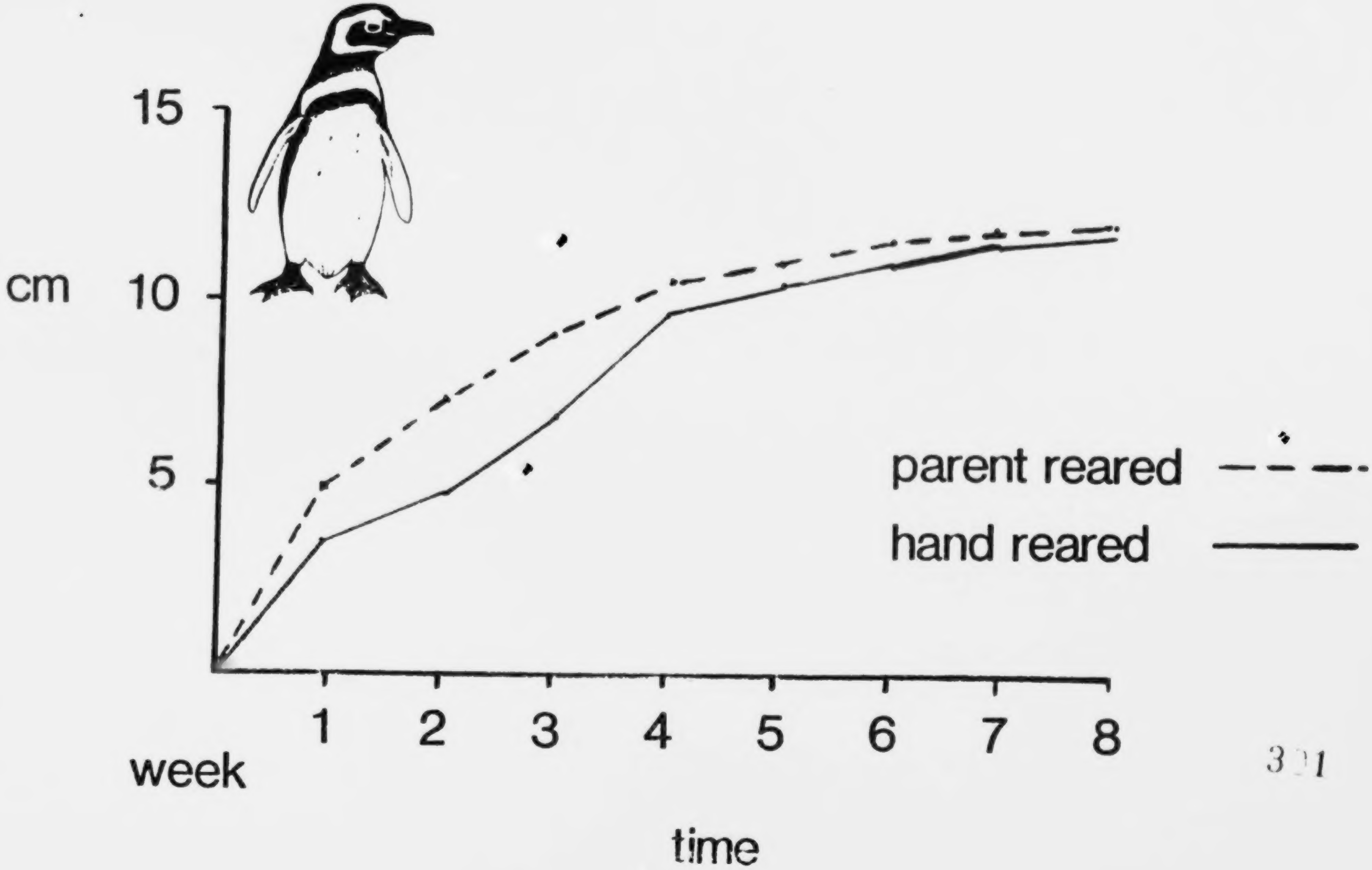


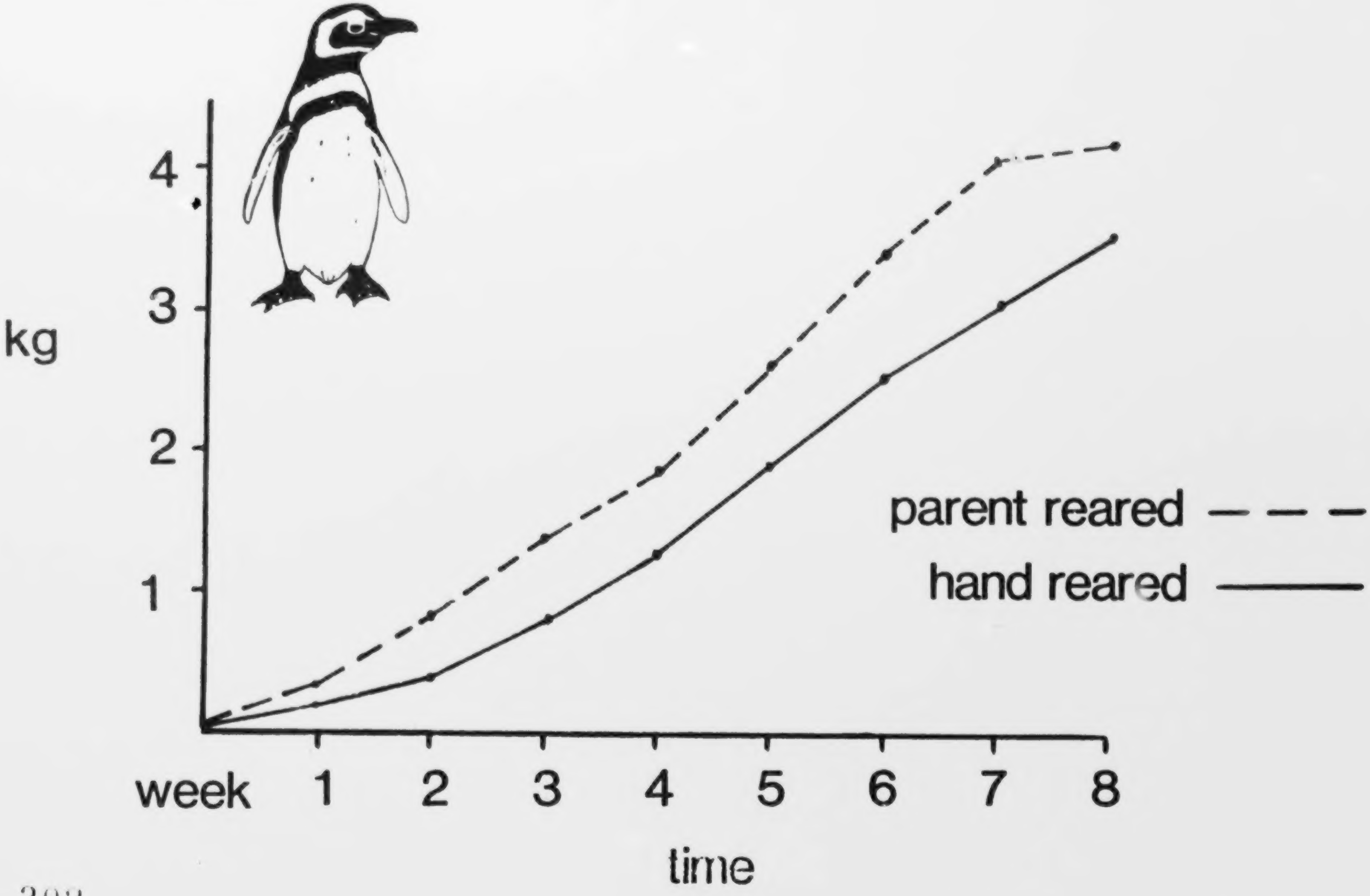
Fig. 7 $\bar{x}$ growth – left foot



3 0

3 1

Fig. 8 $\bar{x}$ weight gain



CAPTIVE BREEDING AND REINTRODUCTION PROGRAM FOR THE EASTERN SARUS CRANE (*Grus antigone sharpii*)

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INTRODUCTION

The International Crane Foundation (ICF) is dedicated to study and propagation of cranes. We have worked with all 15 species of cranes, of which seven species and three subspecies are endangered. We are unusual among AAZPA members in that our work centers around a fairly narrow taxonomic group. This specialization has allowed us to concentrate our efforts and to develop refined techniques for the management of these magnificent birds.

Although we are specialized taxonomically, we have developed far ranging conservation programs. We use cranes as symbols of much broader concepts related to wetland conservation and the relationship of a healthy environment to the quality of human life. The beauty, grace, and symbolism of these creatures has been a wonderful vehicle for inspiring people to become involved in conservation. Our programs include international habitat preservation and education, multi-national cooperation, research, captive propagation, and reintroduction. These diverse programs are integrated into a comprehensive effort toward preservation of cranes and their habitats.

An excellent example of our approach to conservation is our work with the Eastern Sarus Crane (*Grus antigone sharpii*). Our work with this endangered subspecies will be the topic of this paper. What is special to this program is the involvement of a captive breeding facility in the formulation and implementation of all stages involved in this long-term program. This is a cooperative effort involving three contries, governmental agencies, zoos and private breeders. While the techniques for breeding cranes have been developed, our work with reintroduction is still in the experimental phase.

BACKGROUND

The Eastern Sarus Crane can be distinguished from the common Indian Sarus Crane by its smaller size and the absence of white in the neck and tertial feathers. These two subspecies occupy separate ranges. Historically, the Eastern Sarus occurred throughout South East Asia.

Today, this bird appears to have been extirpated from its former range (see Figure 1) (Luthin et al; Madsen 1981). Since 1968, sightings have been rare and unconfirmed. The decline can be attributed to decades of war, hunting, and wetland destruction (Archibald and Mirande 1985).

Today the only known wild population occurs in Northern Australia. It is possible that the Eastern Sarus is a recent colonizer of Australia. The first written reports found for this species are dated in 1953. Data collected by ICF's Director George Archibald in 1972 and 1983 indicates that the range of the Eastern Sarus in Australia is expanding and that its population is growing rapidly (Archibald and Swengel 1985).

Through cooperative work between ICF's international program and other conservation organizations, a program has been developed for the reintroduction of the Eastern Sarus Crane to Thailand. Thailand has been chosen because of the existence of protected wetlands and the commitment of the government to working with public education and reintroduction. Although the protection of additional wetlands is important in this country, the altering of public attitudes is even more important. If the public can be taught to value the cranes and not disturb them, crane-human coexistence should be possible. The Indian Sarus Crane has been able to peacefully coexist with the Hindus in extensive parts of India. There are three objectives critical to the success of this program: to protect wetlands, to obtain cranes for reintroduction, and to develop public education programs. Our first step was to establish several captive flocks and to use young produced from captive breeding as a nucleus for reintroduction flocks.

ESTABLISHMENT OF CAPTIVE FLOCKS

When this research program was conceived in the 1970's, there was an insufficient number of Eastern Sarus Cranes in captivity for the establishment of captive breeding on a scale sufficient for reintroduction. In order to protect birds from the dangers of concentration at one location, we have attempted to distribute these birds at several centers.

An original captive flock of six birds was established at ICF in 1972 from a small group of Eastern Sarus wild-caught in Australia. One pair began breeding in 1978 after adjusting to the seasons of the Northern Hemisphere and nine young were fledged. Another pair began to breed in 1984. Unfortunately one bird from each pair has subsequently died.

One of the original wild-caught birds and two young were sent to Vogelpark Walsrode in West Germany. By 1985 two of these birds had paired but produced only infertile eggs (Kyoko Archibald, pers.comm). Three young were sent to John Henry Dick, a private breeder in South Carolina. All three have been sexed as males.

In order to increase the captive population size and to increase the genetic variability, ICF obtained permission to collect 24 Eastern Sarus eggs and also 12 Brolga eggs from

Northern Australia.

The egg collection took place in the Outback of Australia during the rainy season early in 1984 at a time when most people leave the area. At this time of year the temperatures reach 120°F, rains are sudden and severe, and the area is infested with leeches and crocodiles. George Archibald and his guide, Roy Beasley, visited 60 nests over a period of several weeks. By documenting the time of egg laying it was possible to collect eggs in the later stage of incubation. Then by floating the eggs in water and watching for embryonic movement it was possible to estimate fertility and viability.

The eggs were collected in late February and carefully packed into portable incubators. These incubators were constructed of plywood and divided into two compartments. The top portion was divided into ventilated foam cells and the lower portion held hot water bottles for temperature regulation.

Extreme vigilance and care was required in transporting the eggs during the 72 hour flight. Five chicks emerged enroute, and with constant care they arrived safely at a wintry Wisconsin home.

CHICK REARING

The Eastern Sarus eggs were successfully incubated under normal conditions for most crane species (dry bulb 99.75°F, wet bulb 86.0°F). Twenty of the 24 eggs collected were fertile and 18 hatched. We had just completed our new chick house and it received its first inhabitants in late February. During this period, we also hatched 11 of the 12 Brolga eggs collected.

Several problems were encountered in raising these chicks. There was an insufficient number of pens ready for the unexpectedly high number of chicks hatched, so we built pens while they emerged. The situation was intensified by a short hatching interval of only two weeks. We called in volunteers months ahead of the normal breeding season to assist in providing the constant care these birds required. Because of the large number raised, the amount of rearing space per chick was often cut in half. This resulted in higher weight gain and reduced exercise. Because of the seasonal differences between Wisconsin and Australia, the birds were unable to go outside until they were 63 days old. This again reduced our abilities to exercise or socialize the chicks.

In spite of these handicaps, 17 Eastern Sarus chicks were successfully fledged by standard hand-rearing procedures (Archibald and Viess 1979; LaRue 1981; Putnam 1981).

However, Eastern Sarus females seem particularly prone to imprinting upon humans. Our two adult females respond to tall men by dancing, and a group of four young females raised in 1984 has been affectionately termed the "chorus line" since they run to the front of their enclosure and dance when people approach.

For the egg shipment we had no choice but to hand-rear the chicks. But in the long run, it is necessary to solve our imprinting problem. Imprinting can be avoided by allowing pairs to raise their own chicks. However, each pair will generally raise only one or possibly two chicks per year. By pulling eggs at the time of laying, we have been able to induce multiple clutches and to greatly increase productivity. Last clutches can be left with the parents to hatch and rear. However, it is still necessary to rear chicks artificially hatched from eggs pulled earlier.

Many people feel that foster-rearing is the best alternative to parent-rearing, to reduce imprinting on humans. However, foster-rearing in captivity is expensive and requires considerable investments of time, space, and manpower. There is also a danger of interspecific imprinting and subsequent effects on mate selection. While these problems can be compensated for in captivity, they would doom reintroduction efforts. So far, cross-fostering in wild cranes has not resulted in intraspecific pair bonds between the cross-fostered birds.

As an alternative approach to hand-rearing ICF has been conducting research for rearing cranes in visual isolation from humans. Through the use of crane models and vocalizations, ICF's Behaviorist, Dr. Robert Horwich, is trying to imprint hand-reared cranes on their own species. This summer, Greater Sandhill Crane eggs were collected from the wild and hatched and reared in isolation at ICF. At the time of this writing, six young have fledged and are being soft-released into the wild. These chicks have been successfully imprinted on a "crane-like" image, taught fear of humans, given opportunities to develop normal foraging behavior, and are showing responses to wild cranes.

These techniques show promise for reintroducing hand-reared birds into the wild and may be important for species such as the Eastern Sarus for which there are no natural opportunities to cross-foster in the wild. The techniques will also be important for hand-rearing non-imprinted cranes for captive breeding programs.

BREEDING PROGRAM

ICF has successfully bred two pairs of Eastern Sarus Cranes. In Australia, these birds breed during the rainy season from December to February. At ICF, they have adjusted their cycles and breed at the hottest time of year, in July or August, along with other tropical species. One month prior to anticipated breeding, the protein level of the diet is increased from 19.4% to 23% and extra calcium is provided. Photoperiod is not altered.

At ICF, we have found it necessary to stimulate breeding in Brolgas by using sprinklers to simulate Australian monsoons. Although we have bred Eastern Sarus Cranes, a sprinkling program may also benefit this species. Care must be taken to insure adequate drainage in pens.

ICF encourages natural copulation in its birds. However, hand-reared Eastern Sarus females imprinted on humans are frequently unreceptive to courtship advances by males. For this reason, and also to increase fertility in some birds, ICF practices artificial insemination (AI) on some of its Eastern Sarus Cranes. AI is started in June, one month prior to egg laying, to allow time to condition the birds to handling and semen collection.

We are also working to establish a semen bank for this species. At present our only mature male is the father of both our mature females. This old male is a founder bird and cryopreservation of his semen for later insemination in unrelated females is a valuable tool for insuring his future contribution to the conservation of this species.

The subadult Eastern Sarus Cranes raised in 1984 are now entering the fall of their second year and this is the optimal time for initiating pair bonds. We will attempt to pair these birds with each other or with one of the mature birds. Initially they will be placed in adjacent pens for socialization and then introduced under constant supervision in case of problems with aggression. Some of these birds will be sent to other breeding centers including the Miami Metro Zoo and Mr. John Henry Dick. Additional birds will be sent to the Bangpra Reserve in Thailand as part of the cooperative reintroduction program.

REINTRODUCTION

The ICF in cooperation with the Conservation Program at Vogelpark Walsrode, and the W.W. Brehm Fund for International Bird Conservation has worked closely with the government of Thailand to develop a program for the reintroduction of the Eastern Sarus Crane to its ancestral home. A beautiful breeding center has been constructed at the edge of the Bangpra Reserve. The area is protected from human disturbance and will provide an excellent location for reintroduction efforts. Two Thai researchers from the Thailand Royal Forestry Department, Bubphar Amget and Siriporn Thongaree, came to ICF to study husbandry and propagation techniques during the summer of 1984. The veterinarian responsible for the care of these birds, Dr. Parntep Ratanakorn, has spent a month in 1985 visiting ICF and other breeding centers studying health care.

To initiate reintroduction efforts, ICF sent six young Eastern Sarus Cranes (three males and three females) to Thailand in the fall of 1984. In support of this program, the Queen of Thailand agreed to become the patron for the birds. As a result, the respect of the Thai people for the royal family will be extended to these birds and enhance their protection.

A special and elaborate acceptance ceremony was planned for the arrival of the birds. A temporary pen was constructed beside a red carpet, pavillions were erected, and royal guards stood on the alert. The Royal Princess Somsavali, daughter-in-law to the Queen, graciously received the chicks from Dr. Archibald. After the excitement subsided, the cranes were transferred to their permanent pens. The cranes are currently being paired and not expected to breed until they are at least 3-4 years old.

Captive propagation and release efforts are being backed up by an extensive public education campaign. Mr. Prayuth Intarapanich, an education specialist with the Royal Forestry Department, spent six weeks training with ICF's education department. He is developing comprehensive education plans regarding cranes and wetlands, centered on the captive Eastern Sarus at Bangpra. The presence of these captive birds provides a critical boost to efforts to involve the Thai in wildlife protection. Success of the entire reintroduction program will depend on the alteration of long standing public attitudes toward wildlife.

Once breeding is initiated, reintroduction may be attempted by two methods. First the birds may be transferred to large pens within the marsh and allowed to raise their own young. The parent-reared young would be allowed to fledge out of the pens and fly free.

Second, if isolation-rearing techniques now being developed at ICF are found successful for releasing birds to the wild, Eastern Sarus chicks reared at ICF may be soft-released to the Bangpra wetland. It is hoped that birds released by these methods will eventually recolonize the area.

If successful the Eastern Sarus Reintroduction program in Thailand may serve as a model program for reintroduction of this and other species. Critical to this success is ICF's long-term commitment and the involvement of other organizations, particularly the Royal Forestry Department and other conservationists in Thailand. The people of Thailand have taken a major role in shaping the return of the Eastern Sarus to its former home. The governments of Vietman and the Philippines have expressed interest in establishing similar programs in their countries.

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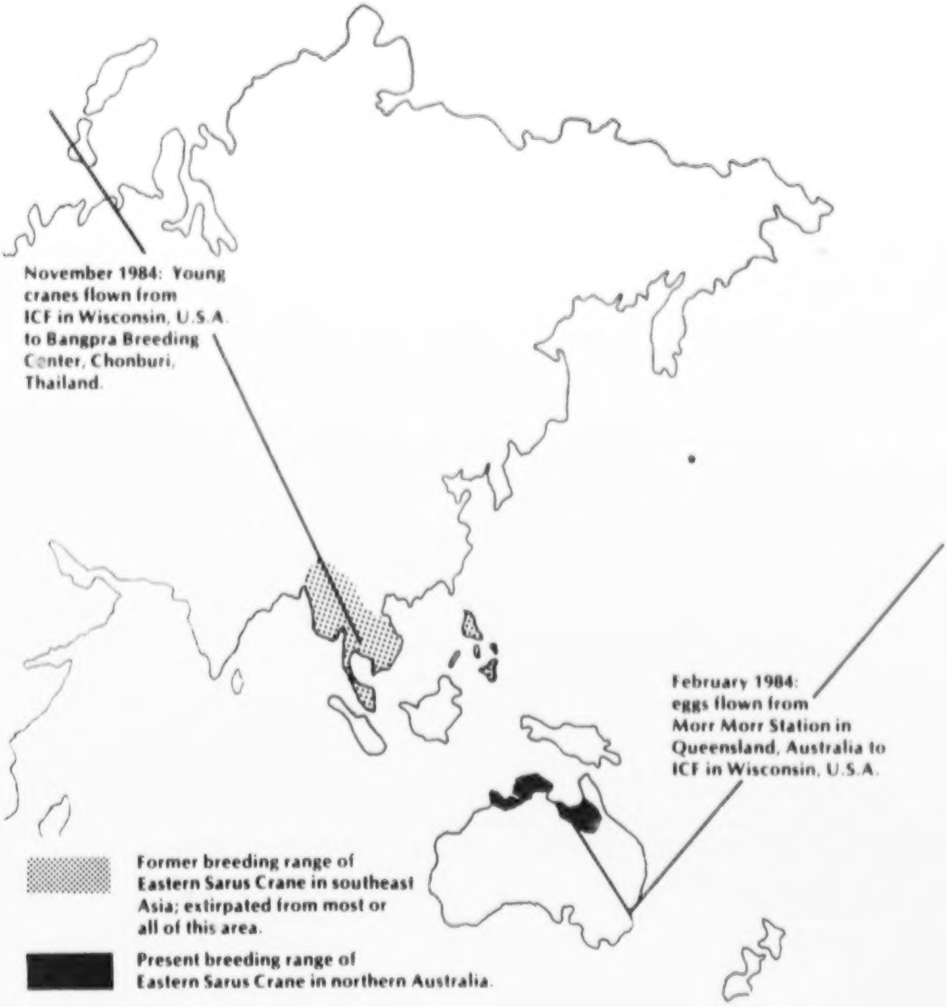
November 1984: Young cranes flown from ICF in Wisconsin, U.S.A. to Bangpra Breeding Center, Chonburi, Thailand.
February 1984: eggs flown from Morr Morr Station in Queensland, Australia to ICF in Wisconsin, U.S.A.
Former breeding range of Eastern Sarus Crane in southeast Asia; extirpated from most or all of this area.
Present breeding range of Eastern Sarus Crane in northern Australia.

Figure 1. Initial movements of the Eastern Sarus Crane involved in the reintroduction to Thailand.

WHAT TO TELL THE ARCHITECT

David E. Anderson, General Curator, Audubon Park & Zoological Gdn.

INTRODUCTION

The planning, funding and construction of a modern zoological exhibit or support facility are all part of a difficult and complex task. The Audubon Park & Zoological Garden has completed eleven major exhibits and support areas in rebuilding the zoo during the past eight years. Many lessons were learned from the numerous problems encountered. This paper relates some procedural guidelines to help manage this process from conception to completion and speculates about the future of exhibit design and construction in a modern zoo.

PLANNING AND FUNDING

Planning---The conception and preliminary program for an exhibit occur before any involvement with the architect. These ought to be in accordance with an institution's master plan, which is essential to long-term planning of the total facility. Planning, however, must take into account more than simply the expansion and renovation in terms of meeting the needs of the animal collection. It must be calculated whether a particular exhibit, which may or may not include its own concessions, will attract a sufficiently greater number of visitors to offset the increased operational cost. This is particularly true in the case of an institution that generates the majority of its funding from the visiting public. Any new facility, and most renovated facilities, will require increased operational budgets in the areas of staffing, utilities, feed costs and the like, as well as increased maintenance costs and equipment replacement. These needs must be kept in mind when calculating whether the exhibit will generate the needed revenue.

Long-term funding --- Exhibits constructed in today's zoos generally are looked upon by the institution as long-term permanent facilities. The zoo community currently is enjoying a period of concentrated capital funding and visitation. This is clear from looking nationally at attendance figures, new exhibit construction and renovation of zoos around the country. We may see a time, however, when visitation and funding are quite different; a time, for whatever reason, when capital donations from public and private sectors decrease, and when visitation levels off or even decreases. One of the strategies at Audubon Zoo to offset this possibility has been to create a capital and operational endowment. A percentage of all types of revenues, funding, and donations each year is put into an endowment fund, the eventual interest from which can be applied to future exhibits, renovations and, if necessary, to offset operational deficits during lean years of visitation. Although our institution develops programs to maintain interest and a high profile, we take seriously lessons learned in the past decades by the academic community.

The 1960's saw a period when colleges received large grants from federal agencies to build a vast array of specialized facilities. Operating grants usually accompanied these capital projects. The high cost of the war in Viet Nam, however, meant a decrease and often a total halt to this funding. The result was a frenzy of fund-searching and, in numerous cases, decreased operation or closure of many of these projects and facilities.

Universities now calculate both the operational and maintenance cost of a new facility and seek capital funds sufficient to include endowment money from which to operate the facility. This strategy is not always feasible in a zoological park; however, it is essential to think in the long term so that one is not left with a situation in years to come when the institution cannot afford to operate the exhibits.

Capital budget --- Determining the capital budget for a specific exhibit involves calculating what funds are available or can be expected to be raised. Included in this resulting figure, however, should be ten or fifteen percent devoted to contingency or change orders. Inevitably problems are encountered during construction, or additions or alterations become necessary, and without funds already in the budget, these changes may be unaffordable. Also included in the budget should be closing costs to pay for graphics, landscaping, furniture and the like. Furthermore, we add the architectural fee to the budget so that there are no monies that are not included in a capital campaign.

DESIGN AND DEVELOPMENT

Exhibit protocol --- Deciding protocol for the exhibit and an animal program are both done before the architects are fully involved. This phase involves deciding the type and number of animals, preliminary space requirements, ideas about the exhibit and how it fits into the the total zoo, ideas for landscaping, concessions and other conceptual themes. But one of the fundamental requirements at this stage is having available animal specialists to start working with the facility from its conception. Major exhibits that cost anywhere from two to ten million dollars are often built upon the advice of architects and consultants alone, after which an aquarist, mammalogist, or ornithologist is hired to put the collection together and manage the exhibit. In the long run, this is a poor strategy, and one of the biggest complaints from directors writing articles about exhibits and zoos is that they must rebuild and renovate from mistakes of the past. Architects and consultants have a certain amount of experience in designing and building exhibits, but there is no way to avoid having, at the earliest stage, an animal person who has experience in the recent past working the animals in the exhibit - someone who can look at a plan and determine night house arrangements, enclosure dimension, support facilities, climate control and other considerations. Consultants and architects forget, or never experience, the details of what must be dealt with as a keeper, and it is the details that will kill you in the actual building of the facility and trying to manage and operate the animals. The cost of hiring the animal curator a year in advance is far offset by building the exhibit right the first time.

Contract documents --- The design/development stage of exhibit construction is a time when the actual architectural plans are put together. And this is a time when we have learned to use keeper staff, individuals who actually may work that species, so that they have a chance to question the architect about exactly how the exhibit works and give input concerning minute details. These details may include location of hose bibs, location of drains, which way doors open, access to exhibit areas by large equipment (something most designers never consider), common alleyways or multiple entrances into exhibits, sufficient storage for tools, and sufficient areas off-exhibit for holding surplus or reserve specimens.

During design/development, in fact in all stages when we deal with the architects, we require that they take notes and send us minutes of the meetings in addition to the notes we make ourselves. This ensures that a two or three hour meeting spent going into detail determining what a barrier measurement may be, which could have resulted from reviewing sixteen other facets of the exhibit, is not lost in the architect's notes and then requested to be recalled or chosen off the top of one's head. It is equally important at this time that both the architectural staff and the animal staff maintain an understanding of the budget, so that the exhibit is not turned into a Rolls-Royce, so to speak, with every piece of gadgetry and excess equipment and luxury space provided that anyone may want. As well as animal people, we also include in design/development meetings a staff maintenance individual who understands structural, electrical and mechanical engineering and can relate simpler methods of producing aspects of the exhibit, or can help us to understand the design phase itself.

Costing --- Once design/development nears completion, we begin the traumatic phase called cost estimating, which is very similar to weather reporting, since a cost estimator has about a fifty-fifty chance of being anywhere close to correct. We have learned to take all, even the most professional of cost estimates, with a grain of salt and try to be aware of what the construction market is in the city at the time, and what prior costs have been for similar exhibits. Even at that, it is tempting to give the architects a budget figure of only about half of what is available. We have learned also that some components of an exhibit, or portions of an exhibit, can be bid as alternates, to be deleted if the construction prices too far exceed the budget.

CONSTRUCTION

Monitoring --- Once the construction phase begins, we start from the outset with weekly formal and informal meetings monitoring construction at each step. The meetings provide a time to review coordination between the general and subcontractors. It is also an opportunity to remind contractors to order materials sufficiently in advance and encourage them to meet the stated completion dates. Our maintenance representative monitors structural aspects and the architects and their engineers tackle problems as they arise. This process, in the long run, saves a lot of headaches; it gives us time to discover problems before construction is complete, and it gives us the time to critique the exhibit as it is being built. We are now, more than in the past, careful in this process not to inundate the contractors with change orders, that is, changes in the construction that add to the cost, usually at an exorbitant rate. Some changes are important, but some are luxuries we simply want and do not actually require. For this reason we are very strict about a change order budget, and very conscious about how change orders are authorized.

Punchlist --- The final stages of construction signal the beginning of a punchlist. This is a process of formally examining the entire exhibit with the contractors, architects, engineers and our own maintenance and animal people inch by inch to look for problems and defects. Although we closely monitor an exhibit during construction, it is at punchlist time that we often find the problems from construction, whether it is a bad paint job, or a wall in the wrong place, or a door opening the wrong way, or whatever. We make it clear in the contract that money will be retained for each punchlist item. Otherwise we have found that for a punchlist to be totally completed may take as long as construction itself, since a contractor off the job usually is reluctant to take crews from another job and return for what they consider minor tasks.

Opening date --- When exhibit construction is initiated there is always a completion date formally given by the contractor, another process akin to weather forecasting. From this date there eventually needs to be set an opening date, sufficiently far in advance to arrange for public relations, official dignitaries and other formalities. It has almost always been the case that the opening date for any exhibit has changed frequently, due to construction delays of one sort or another, despite generous amounts of lead time; and in the end, the people who bear the brunt of the delay are those responsible for placing animals in the exhibit, acclimating them to the enclosures, running introductions and finishing the animal furniture. Therefore, we have learned to take construction completion dates and immediately add a couple of extra months and then add another extra month or two for good measure.

The multitude of problems encountered in exhibit construction are answered only in part with the procedures cited above. These solutions have helped us to at least maintain a balance between cost, design, and the end product. Our experiences, however, have uncovered serious questions about the future implications of exhibit construction.

FUTURE EXHIBIT CONSTRUCTION

Functionality --- Eight years of constructing major exhibits has caused us to reflect that each of these has been a million-dollar or multimillion-dollar undertaking. A review of the history of zoos has shown periodic changes in the state of the art of zoos. The many facilities built around the country in the 1930's, during WPA and other work projects, constituted at that time the state of the art. There was a change in the state of the art twenty or thirty years after that, in the 1950's and 60's, when more naturalistic exhibits were begun; and today, there are being built multi-complex exhibits with intricate rockwork and sophisticated moating and mechanical systems, a new state of the art.

The most bothersome problem in all of this is that one would suspect it inevitable that the state of the art again may change in whatever direction we move in the next three or five or ten years. And we again will be faced with renovating or rebuilding exhibits which now have been an initial cost to us of two million dollars or ten million dollars or even more. The question that we ask the architect is, how does one build an exhibit that may have some adaptibility to future yet unknown changes in the state of the art? Is there a way to build an exhibit that makes it either modular in structure or multi-use in form so that when we learn a different way to house gorillas or a different way to house penguins or rhino hornbills or blackbuck antelope or Siberian tigers, our exhibits can be adapted to this without worrying about raising another two million or sixteen million dollars? We have not found many solutions, and indeed, it may be a problem for which there is no solution, certainly no easy solution. But it deserves intense and immediate research.

Cost --- The cost of construction materials needs to be researched by all architects. A good example to look at is rockwork. Rockwork has become an important aspect of exhibit construction; it is very aesthetic, very appealing to the public, and has become an integral part of almost every exhibit built today. All of us enjoy the results of well-done rockwork, despite the temperament of the artisans who build it. And probably each of us has had a visitor or a V.I.P. tour an exhibit with us and, inevitably, ask, "My goodness, where did you get the rocks for this exhibit?" to which one normally replies, "We flew them in by helicopter from Shreveport." One thing we ask our architects is to speak with the people who build rockwork and ask what they are doing about cost, a cost higher per square foot than any item other than mechanical pumping equipment. It may be possible that new materials can be used to decrease the cost of rockwork, or that precast rockwork can be used. One would hope that architects, engineers and contractors would take it upon themselves to research these areas before being priced out of the market.

Priority --- In the end, it may be the case that we are offering our visiting public too much, that in our quest for his dollar, our quest to display natural habitats and our quest for recognition of our exhibit we have built massive monuments to man and massive architectural edifices which are expensive far beyond the exhibit's purpose and number of animals being housed. There is no doubt that in this time of feeble government support, it is critical for us to attract the visiting public with an exhibit that brings individuals back again and again. Nevertheless, it is unsettling to realize that we are building exhibits for many millions of dollars, money that otherwise may be used to purchase land, support conservation efforts, and satellite breeding centers where the majority of animals could be kept in captive breeding programs. The purposes of zoos and the zoo community are broad and continue to expand. Funds are limited and may become yet further limited. Zoo staff must give careful thought to prioritizing their funds. Our responsibility is, in an immediate sense, to our public and to our institution; but it must be remembered that in the long run it is to the conservation goals of the international community. And our funds collectively must reflect that responsibility.

THE ZOO/UNIVERSITY NETWORK: A CASE STUDY

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There are unlimited opportunities for cooperative efforts between academia (universities and colleges) and zoos and aquariums just waiting to be explored. We are describing one such effort that took place at the University of Michigan during the winter term 1985. We hope that this example will encourage other institutions to initiate or continue in their work to build a zoo/university network.

The School of Natural Resources is a separate academic unit within the University of Michigan. The school has taken an integrative approach to training natural resource professionals, developing problem-solving skills at both the graduate and undergraduate level. The school is also home to the university's professional graduate program in landscape architecture. This combination, design and integrative studies, set the stage for a great adventure in interdisciplinary team problem-solving.

During the fall term 1984 we explored the possibility of using "zoo design" as the focus of a winter term landscape architecture design studio (module). Our enthusiasm for this approach grew as we recognized the vast dimensions of designing a zoo. We wanted to use an actual zoo to focus student attention on a design problem. We also wanted to address design at the broadest level, a master plan, and at the finest, an exhibit design. It appealed to us that students could address the design problem as multidisciplinary teams representing landscape architecture, architecture, zoology, wildlife management, environmental education and graphic arts. The four week studio course suddenly changed to an eight week course, meeting four hours, twice each week in the school's new landscape architecture studio. The course "Zoo Master Planning and Exhibit Design" was taking shape.

The Dean of the School of Natural Resources, James Crowfoot, provided encouragement and significant financial support to bring in outside speakers, purchase materials and employ a student research assistant. Zoo professionals, mostly from the Great Lakes region, volunteered to participate and share their expertise. Twenty zoos provided us with master plans and other planning documents in response to a general request we sent out in November.

The course, as we conceived it, provided the means to conduct an investigation of a topic that was challenging, that needed (according to many zoo professionals) additional attention, that required a multidisciplinary approach, that was attractive to students and professionals from many disciplines, that had potential for contributing to zoological park design, and most of all: a topic that promoted creative thought and unique design solutions.

The primary objectives of the course were (1) to apply disciplinary knowledge and skills in the master plan of a zoological park and an exhibit design; (2) to develop a deeper understanding of exhibit concepts, the interrelationships between plants, animals and people and the methods for communicating these concepts and knowledge; (3) to acquire knowledge on long range zoological park planning/design; (4) to develop an understanding of multidisciplinary planning and design; and (5) to become aware of the factors that determine an individual's responsibilities and contributions to complex environmental development projects.

In order to achieve our objectives, we focused the students' efforts on the preparation of a master plan and an animal exhibit design for the New Indiannapolis Zoo. Our hypothetical case study, based on the Indiannapolis plan, provided each design team with a real site, design program, design mandate and development goals. Each team member was responsible for specific study tasks that contributed to the team's planning and design recommendations. The study topics included: (1) park exhibit and interpretive themes, (2) animal profiles, (3) vegetation for exhibits, (4) pedestrian/vehicular circulation criteria, (5) architectural and site planning concepts, and (6) site furnishings and graphics.

To say the least, we were excited! And so were the students! We promoted the course in numerous university departments as an integrative design studio. We interviewed all prospective students and cautioned each one about the intensive, demanding nature of the course. Thirty students, representing the disciplines we had recruited, embarked on a new experience last March that brought them in contact with 20 professionals representing zoos and zoo design firms. University faculty from Natural Resources, Art and Architecture were invited and scheduled to participate in the critique sessions.

The first four weeks of the course focused on the master plan design problem. On the last day, student teams presented their plans, or design solutions, in a marathon session. It was truly impressive to see the ideas expressed in the drawings and figures produced by the five teams. It was also fascinating to consider the student designs in light of Roy Shea's presentation on the New Indiannapolis zoo immediately following the critique. It was clear at this point that we demanded an amazing performance from the teams in producing a presentable master plan in a four week period.

The exhibit design problem, the second four week segment of the course, was modified after discussions with the five teams. We needed to compensate for the extreme "burn out" the teams experienced from the intensive first four weeks. Our modified approach allowed for more creative responses to the problem and completely changed the format for the final presentations. The students needed extra studio time because our course schedule frequently included two, three and sometimes four zoo professionals in any one four hour studio session.

Mustering all the energy to be found, students rose to the occassion for the presentation of exhibit designs. Our revised format avoided the marathon presentation session by restricting the team presentations to ten minute summaries. Following the presentations, faculty and professional participants circulated around five exhibits or displays constructed by the teams. Each display contained drawings, audio-visual presentations and three-dimensional construction to provide opportunities for creative presentations of the design solutions. Each display was unique because of the approach to the presentation and the ability of groups to select the exhibit of their choice to fit the master plan.

Refreshments were an added feature of the final presentation, creating an informal atmosphere and allowing students and participants to mingle around the displays. The final 45 minutes of the final studio period were dedicated to an open forum in which the zoo professionals and university faculty shared their impressions of the students' work. Without a doubt, all students thoroughly enjoyed this final discussion that brought the course to an inspiring conclusion.

It was exciting, but where did this course lead us? We began the course with the idea that we would produce a "proceedings" based on the presentations of our 20 professional participants. Discussions on the proceedings lead us to a topical approach that would incorporate the comments of particpants in specific chapters that would make up a book on zoo design. Again, Dean James Crowfoot has been instrumental in providing financial support to prepare the text and publish the course book.

We also sponsored a short course, "The Role of Zoos in Conservation", as a primer to the design studio to familiarize students with the goals of zoos. The four week course touched on the history of zoos; the roles of design, education and research in zoo conservation; ISIS; SSP; and future prospects.

The interest and enthusiasm generated by these courses served as a catalyst to motivate four graduate landscape architecture students to pursue zoo-related thesis topics. The first completed study was for a new elephant exhibit at the John Ball Zoo. A second student has just received substantial research support to assist in the design of the national zoo for Costa Rica. A third student is focusing on interactive designs while the fourth is evaluating the impact of "immersion" exhibits on the viewing public. They have been encouraged to present their findings at the appropriate regional AAZPA conferences.

Although we did not intend to build a training program for future zoo employees, three of our graduates have found employment in zoos following the completion of the courses. The concept of using zoos and aquariums as laboratories for educational institutions is nothing new, but we feel that our recent effort has revealed some exciting new dimensions that have not been fully exploited. The School of Natural Resources is continuing its study of zoos and plans to hold a professional seminar during the winter term 1986. The zoo/university network needs to be explored by all of us, because the benefits are just too great to pass up!

* * * * * *

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MIXED SPECIES WALK-THROUGH AVIARIES
BLESSING OR BURDEN?

Bruce Bohmke, Curator of Birds, Kansas City Zoological Gardens
Mary Healy, Curator of Birds, San Antonio Zoological Gardens

Zoo design is a rapidly evolving field. Changes in exhibit philosophy, as well as technology, have meant vast improvements in the way animals are kept in zoos. It is no longer sufficient to build exhibits based only on their ability to contain the animals. Now the emphasis is on exhibiting them in natural habitats.

In the avian field, one of the most obvious outcomes of this changing attitude is the walk-through, mixed-species aviary. The zoo visitor has become less tolerant of caged animals peering through bars and more aware of animals "Born Free". This design satisfies the desires of the visitor; in a well planted, natural setting, the visitor perceives the birds to be free. By being in the exhibit with the animals, he shares their environment and is much more aware of the sights, smells and sounds around him.

This style of exhibit gained popularity very quickly and numerous zoos have constructed similar-style exhibits over the last two decades. Clearly the goal of these early flight cages was primarily to serve as a positive experience for the visitor. An exhibit to "wow" them with large numbers of birds and plenty of flash and color. In an article in the International Zoo Yearbook 1975, Kerry Muller describes the exhibit philosophy behind some of the early flight cages. "Their entire concern is with providing a spectacle for the public ... the sole criteria for their choice being color, size, and variety." In a paper given at a 1975 Regional AAZPA meeting, Bob McMorris describes the same sort of outdated exhibit criteria: "...the decision as to which birds were placed in this exhibit were based originally on color and not compatibility".

The old exhibits still exist and new ones are being built almost annually. Have the goals of such an exhibit changed? With conservation being the cry of zoos in the 1970's and 1980's, are the flight cages reflecting this change in animal management philosophy? To a great extent they are. The numerous articles that are written about such aviaries fall into two categories, 1) those written at the time of the opening, eg. (Klos 1962, Mottershead 1966, Griswold 1972, Lint 1960),and 2)those written years later as renovations and improvements are needed, eg. (Reuther 1973, Reed 1966). For the most part, the improvements are a shift from the emphasis on visitor satisfaction to meeting the needs of the birds.

The changes were prompted by several factors. Conservation has gained importance and these aviaries typically had low reproductive potential and high mortality. At the same time, education and the quality of the visitors experience has received increased attention. The goal is no longer to just expose the public to a large variety of animal species. To really teach them about the species, it is necessary to simulate the natural environment of the animal.

The biggest change came in the number of birds that zoos attempted to exhibit in these aviaries. Numbers of species and specimens have been greatly reduced. Many aviaries of the 1960's had a density of birds equivalent to one bird for every 25-50 square feet. By contrast, the average of ten zoos contacted recently was well over 100 square feet of space for a single bird. More of an effort was made to exhibit species in pairs. Many zoos tried to develop a unifying theme, such as a common geographical origin to illustrate how the species would co-exist in the wild. Although this is a step in the right direction in concept, new problems were generated. Paired species that were nesting were often much more territorial and aggressive towards other birds. Nesting mortality was high. The "theme" concept limits the choice of potentially compatible species.

Some of the biggest problems with such an exhibit are inherent in its design and can be managed to some extent but not solved. The lack of control, inability to capture individuals or at timesobtain an accurate inventory are the major frustrations expressed by those curators we contacted. Other aspects such as plant care, pest control, graphics, and new bird introductions can all be handled in some fashion. The written proceedings will include a section on the various ways those and other problems are handled. However, even with all the problems involved, it is still recognized that these are very popular exhibits and if managed properly, mortality can be minimized and breeding potential maximized. Such exhibits can be very effective and if the limitations are not ignored, the avian population need not suffer.

With that in mind, it seems that the best way to minimize significant losses in this style of exhibit is through the careful selection of species. There is always a risk involved in releasing a bird into a flight cage, or any new environment, but that is why it is so critical to take into account the availability of the species when selecting birds to be exhibited. The status in the wild as well as captivity should be evaluated. Well established, commonly captive-bred species should be chosen over more rare species. Many institutions have active off-display breeding facilities, giving them the potential to become their own suppliers, restocking the aviary with captive-bred offspring. Fortunately, some species have done so well in captivity that the current need to reproduce them has decreased. As long as their status is carefully monitored and maintained, these species are a good choice. White-cheeked turacos and superb starlings are two examples. In 1966,the International Zoo Yearbook reported less than ten superb starlings hatched at three zoos. In 1984, 143 superb starlings were hatched in 24 zoos. The International Zoo Yearbook reports only two white-cheeked turacos hatched at one zoo in 1966. In 1984, 50 turacos were produced at fourteen zoos.

There are a number of species whose population in captivity is heavily skewed towards one sex. Though not yet well established in captivity, they are still a good choice because they are not depleting a potential breeding population, eg. bare-throated bellbird.

Reproduction is not impossible by any means; a number of zoos do quite well, but most still express the attitude that the birds breed in the flight cage despite the obstacles. In a survey of ten zoos, 31% of the bird species housed in flight aviaries exhibited some reproductive behavior. The survivability of offspring, however, was only 18%. Most successful reproduction occurred in larger, relatively aggressive groups of birds such as waterfowl, starlings, rails and pheasants. Clearly, some species do benefit from the spaciousness of a large planted aviary. Hammerkops, with their large nest requirements, are a good example.

The responsibility rests with us to practice what we preach. Aviculture has made great progress in captive reproduction programs and they should not be compromised by reverting back to exhibits for exhibit's sake only. Vast improvements in techniques have greatly increased the compatibility between "display" and "conservation".

If we make the effort, we have the ability to reduce mortality, increase reproduction, improve education and conserve rare species without sacrificing the public's enjoyment.

We would like to thank the following people for contributing ideas and information for this paper: Jim Pichner, Minnesota Zoo; Mike Coker, Topeka Zoo; Mary Lieras, San Diego Wild Animal Park; Bruce Miller, Oklahoma City Zoo; Ron Morris, North Carolina Zoo; Lucy Gemlo-Greer, Brookfield Zoo; Ken Redman, Sedgwick County Zoo; Bob Berry, Chelle Plassé and Scott McKnight, Houston Zoo.

Appendix I

Outline of problems and attempted or suggested solutions:

A. Climate

   1) Move birds inside during winter months

   2) Provide shelter boxes and/or heat sources

   3) Exhibit only those species hardy enough to tolerate

B. Plants

   1) Establish well before introducing birds

   2) Monitor continually, replace regularly

   3) Utilize pest controls safe for birds

   4) Utilize rocks and logs to protect roots

   5) Place wire around plants until established

C. Competition and Aggression Between Birds

   1) Introduce least dominant first

   2) Maintain plants for cover

3) Exhibit odd sex birds or immatures
   (To forstall breeding and agression)
4) Provide multiple feed stations and nesting sites
5) Remove repeat offenders

D. Glass Walls/Ceilings or Skylights

1) Tint glass
2) Cover when introducing birds using sheets, soap, tape
3) Remove a few primary feathers to slow bird initially

E. Aggression From Birds to Public

1) Design walkway to allow majority of exhibit to be inaccessible to public
2) Remove repeat offenders
3) Avoid imprinted birds

F. Aggression From Public To Birds

1) Design walkway to allow majority of exhibit to be inaccessible to public
2) Remove repeat offenders
3) Avoid imprinted birds
4) Provide adequate rail or border along walk
5) Don't allow public feeding
6) Station volunteers or keepers to monitor

G. Graphics

1) Duplicate in several areas
2) Supplement with printed hand-out (trash problem)
3) Supplement with volunteers or keepers

H. Public Over Crowding

1) Charge nominal fee
2) Design for one way traffic

I. Monitoring Birds

  1) Color band
  2) Inventory daily
  3) Use binoculars
  4) Establish routine feeding schedule

     Use live food to attract birds for inventory before public enters exhibit

J. Introducing New Birds

  1) Use holding cage
  2) Introduce during non-breeding season

K. Removing Birds From Exhibit

  1) Build trap doors into feed stations
  2) Design rock work for easy access to high spots in exhibit

L. Predation of Baby Birds By Other Bird Species

  1) Remove eggs or chicks for hand rearing
  2) Remove predator
  3) Remove young at critical fledging time

M. Choice of Species

1) Consider status in the wild and captivity and evaluate breeding potential in a flight cage setting

   eg. pro: Hardy bird such as Hammerkops which require a large area for nesting

   con: Delicate softbills that would breed only in a low competition enviroment

  2) Establish controlled breeding facilities at your zoo to stock flight cage
  3) Choose species being readily bred at other facilities

4) Vary family groups represented

ie. one starling species, one pigeon species, one pheasant species

5) Vary species according to habitat niche

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THE ROLE OF THIRD WORLD ZOOS
THE BELIZE ZOO
AN EVOLVING CASE STUDY

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The Belize Zoo
Belize, Central America

J. Thomas Atkins, Principal
Jones & Jones
Architects & Landscape Architects

ABSTRACT

A Master Plan for the expansion of the existing Belize Zoo, Belize, Central America, is currently under development. The zoo site, approximately 1000 acres of pine/oak savanna, is located midway between Belize City, the population center of the country and Belmopan, the capital of Belize. This location is immediately adjacent to the major east-west highway and is safely inland from potential hurricane storm surges. The development plan focuses upon the educational, research, and conservation opportunities provided by a zoological institution within a Third World country.

The theme of The Belize Zoo will focus on "a walk through Belize," a journey through a series of replicated natural habitats. The new zoo will provide expanded educational programs focusing on Belize ecosystems, wildlife appreciation, the impact of human activities upon natural habitats, endangered species and conservation efforts.

As planned, The Belize Zoo will facilitate the development of field research stations. The facility has the potential to become a staging point for bush habitat research, an animal breeding center, and a focal point for appropriate species release programs. Several U.S. zoological institutions have shown considerable interest in the research/conservation programs of The Belize Zoo.

BACKGROUND

In the neotropical country of Belize, Central America, the largest city is Belize City. Sixty miles west of Belize City is the country's capital, Belmopan. Located on the major east-west highway between these two major population centers is The Belize Zoo.

The coming of age of The Belize Zoo is a result of an evolution of strategies, concepts and environmental philosophy. Beginning as a collection of wild animals used for award-winning British natural history documentaries, the zoo started as a project to financially support these animals when funding was severely restricted during the winter of 1982. Some of the animal enclosures were modified for public viewing, interpretive natural history signs were developed for the exhibits, and an admission sign of one-dollar was placed in front of the compound. A zoo was born.

There are three primary reasons why The Belize Zoo enjoyed quick success and overwhelming support:

1. There had never before been a zoo in Belize.
2. The native fauna of Belize is dramatic, beautiful and discreet.
3. Well over half of the Belizean population was unfamiliar with its own native wildlife.

But starting in January 1983, the Belizean people could see, many of them for the first time, their natural animal, Baird's tapir. And, as everyone visiting the zoo received a guided tour, attention was readily drawn to the serious matters of habitat destruction and vanishing neotropical wildlife.

All of the animals in The Belize Zoo are from Belize. There are nineteen species of mammals, twelve species of birds, and seven species of reptiles. In all, a total of sixty-two specimens. As the development of The Belize Zoo progresses, more native wildlife will be added, and an emphasis will be placed upon pairing each specie.

Belize is a country which has 45% of its forests remaining. But with areas of the world's tropical forests the size of Great Britain disappearing yearly, conservation education -- increasing local awareness of the importance of maintaining the biological diversity of the surrounding environment -- becomes critically important to the preservation of this diminishing resource. The education program at The Belize Zoo was established early on with unanimous approval from the government of Belize. To date, in a country with a population numbering only 150,000, over 2,000 school children have passed through the gates of the zoo, each receiving a guided tour emphasizing wildlife conservation. There is no charge for each child to enter The Belize Zoo. There is, however, a charge for each child to exit the zoo. No child leaves the zoo grounds without knowing and understanding the meaning of the word, "extinct."

With the growing success of The Belize Zoo came the necessity of expansion. Not only were schools and other Belizean citizens visiting each week, but an ever-increasing number of foreign tourists were driving thirty miles west of Belize City to experience this unique collection of native wildlife. Also, organized tour groups from the United States began coming to Belize and to date, every group has included a tour through The Belize Zoo in their itinerary.

Land was plentiful and available for relocation and permanent establishment, but there was no plan to implement the necessary move. Hoping to make contact with someone having expertise in the area of zoo design and construction, the founder and director of The Belize Zoo, Sharon Matola, went to the 1984 conference of the AAZPA held in Miami, Florida. It was at this conference that she met and talked with principals from the firm of Jones & Jones, of Seattle, Washington. After discussing the challenge that faced the development of this project, Jones & Jones offered to donate the master plan for The Belize Zoo.

THE PLANNING PROCESS

The development of the master plan for The Belize Zoo followed the planning process used by Jones & Jones in all zoological projects carried out by the firm. This process involves a series of intensive workshops occurring at critical points in the course of the project. Both the client and the consultant, as the project team, are directly involved in preparations for the workshops and in the workshops themselves. Such involvement helps ensure a continuity in the planning process, provides an opportunity for all team members to consider the unique requirements of the project, and reduces potential logistical and communications problems which may occur in long distance consulting.

In the development of a master plan for The Belize Zoo, the Jones & Jones project team included Johnpaul Jones and J. Thomas Atkins, principals with the firm; Dr. Dennis Paulson, Resource Associate; and Roger Sherman, Associate Landscape Architect. The client team included Sharon Matola, Director of The Belize Zoo; and William Hasse, Manager of the Zoo.

In the spring of 1985, Johnpaul Jones and Tom Atkins met in Belize with the Zoo Director and zoo staff for an initial planning workshop. The existing and potential zoo site and animal collection were evaluated and preliminary concepts developed. The project team also met with government officials and representatives of conservation groups to discuss the importance of The Belize Zoo to the country and to worldwide conservation efforts.

In workshop sessions held in Seattle in May, 1985, efforts focused on refinement of the master plan concept and on developing preliminary drawings for selected animal exhibits. As a result of the workshops, a master plan for The Belize Zoo, as well as exhibit concepts for selected exhibits, were developed.

These products, along with images of the existing zoo, Belizean wildlife, and their habitats, have been incorporated into a 10-minute videotape produced in Belize, which describes the opportunities found at the zoo and the importance of the zoo to Belize. The plan graphics and videotape have been used in zoo fundraising efforts.

THE PLAN

In their initial workshop, members of the project team identified elements which might be emphasized in developing a master plan for The Belize Zoo, including education, research, and tourism. A zoo theme, "A Walk Through Belize" was agreed upon. This theme provided an exceptional educational opportunity, visitors to the zoo would not only see the native animals of Belize in their respective habitats, but would also be able to appreciate the distinctly different natural environments in which they live.

The potential for research at The Belize Zoo was an important consideration, and areas for captive breeding and release-conditioning were included in the planning phase. With an abundance of land surrounding the zoo, facilities for present as well as future research programs were incorporated into the master plan.

In addition, the plan took into consideration the growing tourism industry in Belize. As more people travel to this Caribbean nation, interest grows in The Belize Zoo and the opportunity it affords to learn more about this neotropical environment and its native wildlife. As designed, the master plan offers a unique opportunity for tourists to see and photograph dramatic Belizean wildlife, while at the same time showing the various habitats necessary to support them.

Critically important, the issue of habitat destruction and the coincident loss of wildlife, will be a central theme of the zoo. Visitor's attention will be drawn to the fact that tropical forests are disappearing at the rate of fifty acres per minute, and that the animals they observe face a precarious future as the habitats which support them disappear.

The Zoo

The new Belize Zoo is to be located on a 1000 acre pineland-savanna site. This site and an adjacent 1700 acre site will provide an adequate land base for all future zoo operations. The focal point of the site will be the 25-acre plant and animal exhibit areas.

The zoo, organized around the theme of "A Walk Through Belize" will provide replicated natural habitats for a significant number of the species of wildlife found in Belize. These exhibits will be organized into 4 environmental zones, each reflecting a unique aspect of the tropical environment. The visitor encounters these environments as if on a journey traversing Belize. Environments which are adjacent to each other in the wild, will have the same relationship at the zoo.

Figure 1 presents a Diagrammatic Plan for The Belize Zoo. The plan is organized around 4 environmental zones: the pineland, forest edge, hill forest and river forest. Also presented are the exhibit habitats and animals found in each exhibit.

Since the zoo is located in the pineland savanna, the first environment the visitor experiences is the pineland. The visitor will enter this environment after he has passed through the entry complex (see Figure 2). The pineland is a flat area, vegetated by open pine stands with scattered shrubs, grasses and marshes. This habitat is for animals related to more northern and less tropical environments.

The next habitat encountered will be the forest edge. This area will include forest edge environments as well as areas in various stages of succession. Areas of blowdowns will be simulated.

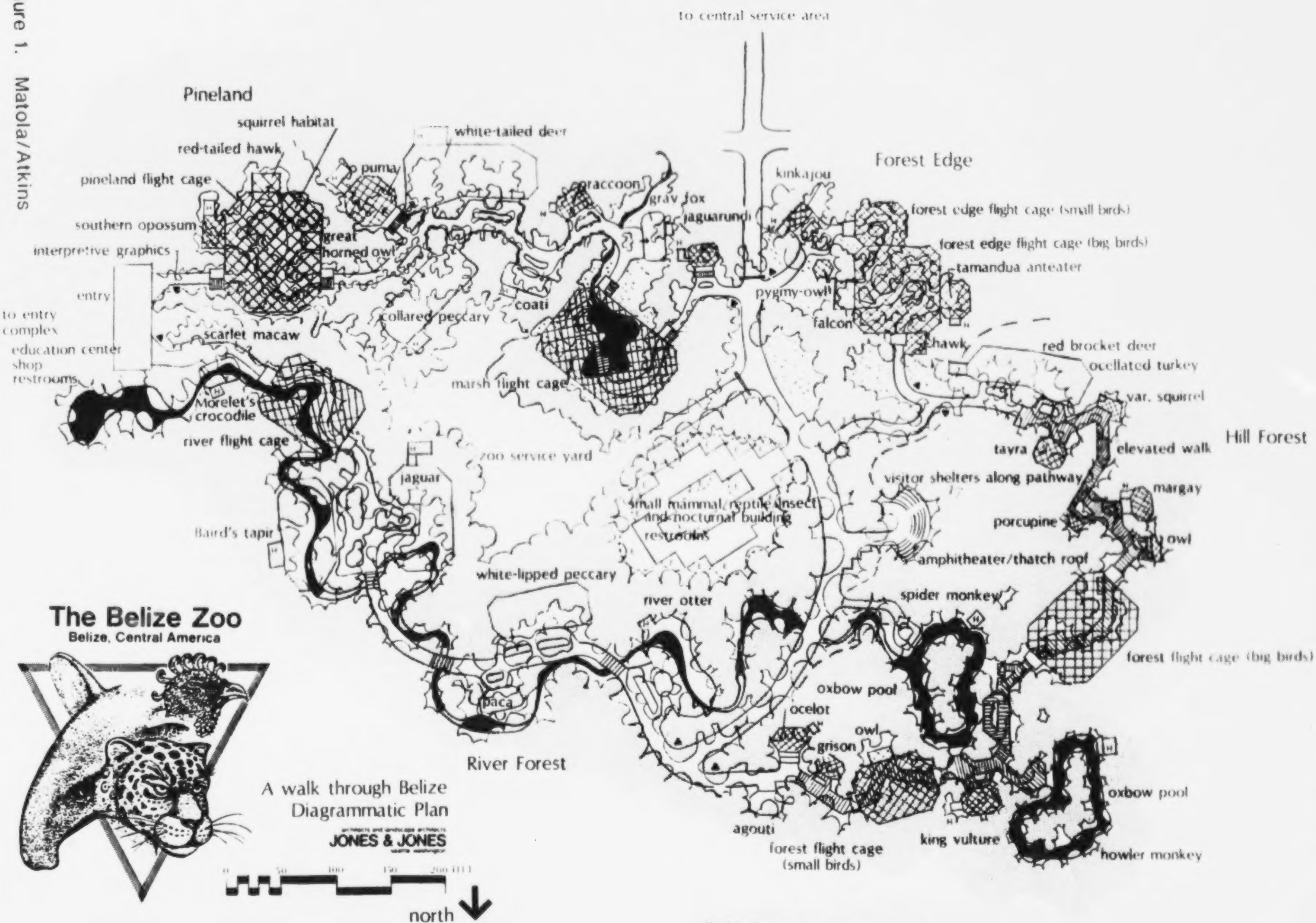
After passing through the transition zone of the forest edge, the visitor will encounter the hill forest area. Here the visitor will begin a journey into the canopy of the tropical forest and experience the vertical organization of the forest. Visitors will have the opportunity to view many aboreal animals as they ascend an elevated walkway into the canopy. At the beginning and end of this elevated walk experience, terrestrial animal exhibits will occur.

The final habitat area encountered is the river forest. Within this area both terrestrial and aquatic animals will be exhibited.

A small animal building is located in the center of the zoo complex. This building will provide nocturnal exhibit areas as well as other small mammal, reptile and insect exhibit areas.

The visitor will experience the zoo as a series of replicated habitats. Exhibit views will be carefully controlled, so that the visitor will view the animals and not other people, animal holding areas or exhibit barriers. A majority of exhibit viewing areas will occur on small pathways or areas off the primary pathway. This separation will provide the visitor an opportunity to view the animals in a more intimate setting. It is hoped that the visitor will view the animals as if they were encountered in the wild. By controlling views and exhibiting animals in their

Figure 1. Matola/Atkins


to central service area
Pineland
squirrel habitat
red-tailed hawk
pineland flight cage
southern opossum
interpretive graphics
entry
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education center
shop
restrooms
great horned owl
scarlet macaw
puma
white-tailed deer
collared peccary
coati
raccoon
gray fox
jaguarundi
marsh flight cage
Morelet's crocodile
river flight cage
zoo service yard
jaguar
Baird's tapir
white-lipped peccary
small mammal/reptile/insect and nocturnal building
restrooms
river otter
paca
River Forest
kinkajou
Forest Edge
forest edge flight cage (small birds)
forest edge flight cage (big birds)
tamandua anteater
pygmy-owl
falcon
hawk
red brocket deer
ocellated turkey
var. squirrel
Hill Forest
tayra
elevated walk
visitor shelters along pathway
margay
porcupine
owl
amphitheater/thatch roof
spider monkey
forest flight cage (big birds)
oxbow pool
ocelot
grison
owl
agouti
forest flight cage (small birds)
king vulture
oxbow pool
howler monkey
The Belize Zoo
Belize, Central America
A walk through Belize
Diagrammatic Plan
JONES & JONES
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natural environments, the visitor may experience a sense of surprise, as well as admiration for the animals they see.

Operations and Research Facilities

Figure 2 presents the conceptual layout for the zoo operations and research facilities. This diagram illustrates the functional relationships of the facilities.

As with other zoos, the exhibit area a visitor experiences at The Belize Zoo is a small percentage of the total zoo facility. At The Belize Zoo, these facilities are grouped into four categories:

1. Visitor facilities
2. Animal exhibit areas
3. Zoo service facilities
4. Research and breeding center facilities

Many of the functional elements, such as the staff housing, health care facilities, quarantine area, maintenance facilities, food production and food preparation areas, and firebreak are shared by both the zoo and research stations.

The visitor's first experience of the zoo will be from facilities located outside the exhibit areas. These facilities include the parking area, picnic area and adjacent playground where visitors can refresh themselves prior to entering the zoo. In addition, an alternative energy area is also located outside the entry. This area, while producing power for the zoo, will also provide interpretive information about alternative energy sources.

Once inside the gate the visitor will encounter the visitor services center and educational area. The visitor services center will provide shops, food stand, first aid, and restroom facilities. The administrative complex will occur across the entry area from the visitor service center. This area will include an air-conditioned library and audiovisual facility and a covered amphitheater for meetings and wildlife presentations.

The second group of facilities shown on Figure 2 are the animal exhibit areas. This category has been discussed in detail in the preceding text and is illustrated in Figure 1.

A third category is the operations and management service facilities. These facilities, shared by both the zoo and research station, will include animal health care and quarantine facilities; food production, storage and preparation facilities, administrative facilities, and housing for staff and research center visitors.

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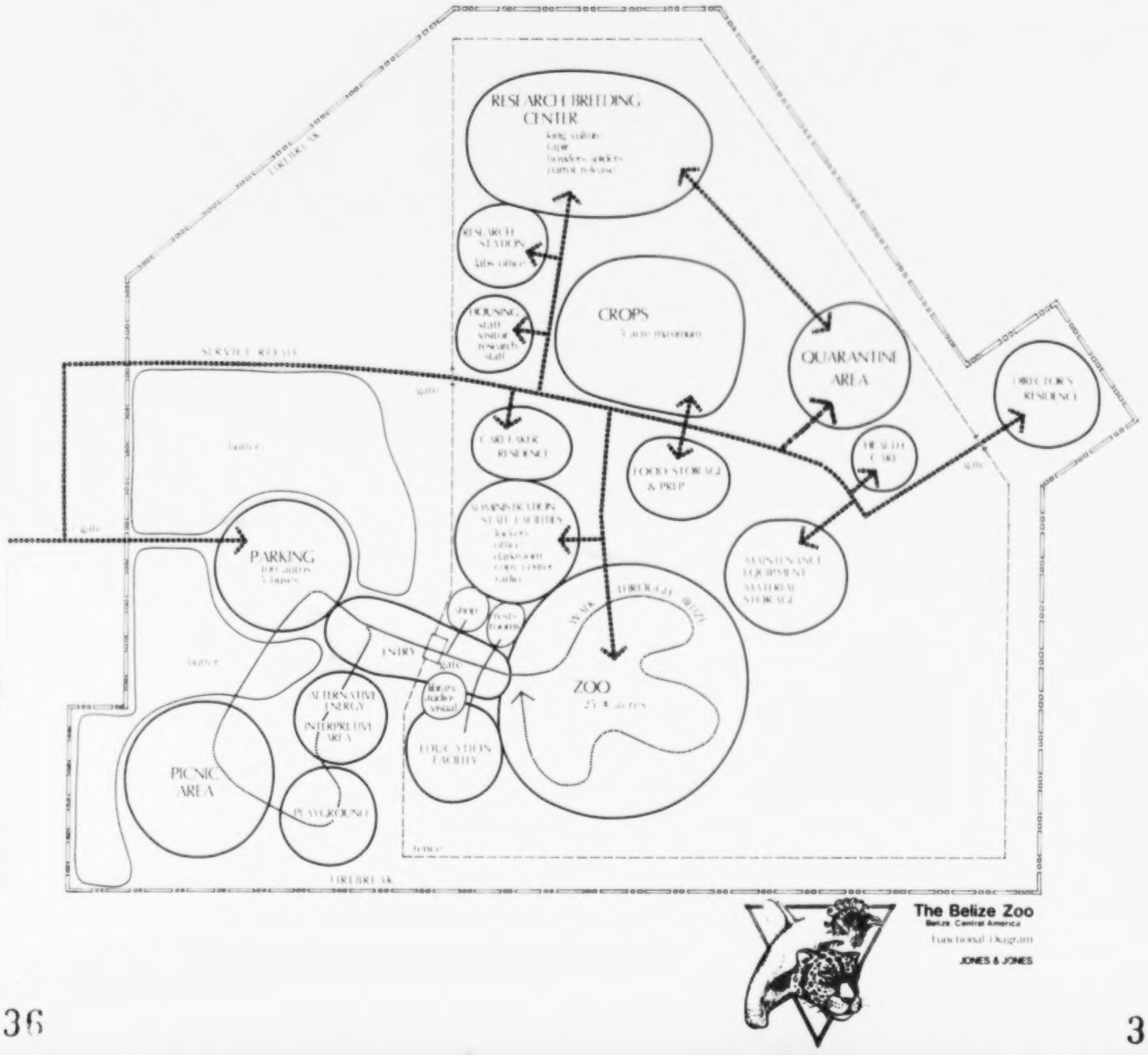
RESEARCH BREEDING CENTER
king vulture
tapir
howlers-spiders
parrot release
RESEARCH STATION
labs office
HOUSING
staff
visitor
research staff
CROPS
5 acre maximum
QUARANTINE AREA
DIRECTOR'S RESIDENCE
SERVICE ROAD
gate
CARETAKER RESIDENCE
FOOD STORAGE & PREP
HEALTH CARE
ADMINISTRATION STAFF FACILITIES
lockers
office
darkroom
copy center
radio
MAINTENANCE EQUIPMENT
MATERIAL STORAGE
buffer
PARKING
100 autos
5 buses
shop
rest-rooms
WALK THROUGH ZOO
ENTRY
gate
ZOO
25 ± acres
library audio-visual
ALTERNATIVE ENERGY
INTERPRETIVE AREA
EDUCATION FACILITY
PICNIC AREA
PLAYGROUND
fence
FIREBREAK
The Belize Zoo
Belize Central America
Functional Diagram
JONES & JONES

Figure 2. Matola/Atkins

The fourth group of facilities includes those related to the research and breeding center. These facilities will include laboratory and administrative buildings as well as space for temporary facilities as required by participating institutions. These facilities will be isolated from the other zoo facilities and could, in fact, be a separate compound surrounded by its own perimeter fence and firebreak.

THE FUTURE

Funding for development and permanent establishment of The Belize Zoo has presented a problem. Although enthusiastically supportive of the zoo, the government of Belize is economically depressed and can offer no direct financial assistance: however, the use of government-owned construction equipment for use in early phases of zoo development has been discussed.

A strategy was developed to finance the zoo by approaching United States corporations which had interests in Belize, conservation agencies who realized the research potential, and private donors who saw the value of an established quality zoological institution in a neotropical Third World country.

Unheard of in the North American zoo world, construction of the planned new exhibits and facilities at The Belize Zoo can be financed for under one million dollars.

Started as a modest attempt to establish a basis for wildlife and conservation education in Belize, The Belize Zoo is now proud to have the support, in principle, from:

The Government of Belize
The Belize Audubon Society
The New York Zoological Society
The National Zoo/Smithsonian Institution
The AAZPA
The Nature Conservancy International
   World Wildlife Fund

The expansion and permanent development of The Belize Zoo is only part of this current zoological movement. Programs are beginning which promise to have a positive affect on the overall conservation effort taking place in the neotropics, as well as having potential benefits for zoological parks in North America.

They include:

- A pilot program to breed soft-bills, begun in collaboration with the National Aquarium in Baltimore, Maryland.
- A breeding project concerning Baird's tapir, an endangered species, initiated by the Wildlife Preservation Trust International

- A king vulture release program, initiated with the cooperation of the Jackson Zoo.
- A parrot release program, receiving approval from the New York Zoological Society, the Belize Audubon Society, and the government of Belize, begun in the fall of 1984.

CONCLUSION

The Belize Zoo stands as an example of the critical role a third world zoo can play in international conservation efforts. Serving as research 'outposts', zoos in developing countries can provide unique opportunities to participate in special research, breeding and release programs.

Zoos in third world countries also provide an invaluable resource in furthering local environmental education. The concept of exhibiting regional animals and habitats reinforces the educational theme emphasized at The Belize Zoo: "These are your animals and habitats -- help protect them." The "walk through" concept could be used in any third world zoo to present this important conservation message.

The approach presented here, while dealing with the proposed facilities at The Belize Zoo, goes beyond a single master plan for a zoo in a developing country. The process proposes a strategy for addressing worldwide conservation issues through the collective efforts of established zoological institutions, and zoological 'outposts' being developed in third world nations.

Tampa Florida...The Rebirth of an Aging Zoo

Douglas Porter, Superintendent
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Tampa Florida 33604

An ageing zoo in a large metropolitan area - should it be renovated or demolished? The story has been played out in countless cities around the country, and though many cities have redesigned and renovated existing zoos few have done as radical a face lift as the City of Tampa. Tampa's Lowry Park Zoo has languished in one of the city's loveliest parks for 25 years. While zoos in other cities were developing new concepts in zoo management and design, Tampa's Zoo was virtually standing still. Chain link exhibits were constructed that would have served as little more than holding cages at other zoos. Management practices were also far behind national standards, with little effort put into maintaining records, researching diets or keeping up to date on current zoo technology.

The rebirth of the Lowry Park Zoo actually began in 1982, when the Mayor of Tampa appointed the Lowry Park Zoo Association to investigate the alternatives for Tampa's ageing zoo. The basic question was, should it be renovated or should it be torn down? Complicating matters was the presence of Busch Gardens. Tampa could already boast one of the finest animal collections in the country. The Lowry Park Zoo Association questioned, interviewed, and investigated, and soon determined that though Busch Gardens did offer a tremendous resource to the citizens of the Tampa Bay area there was still a very real need for a small, inexpensive alternative. The people not only wanted an inexpensive, small zoo, they supported the current zoo quite well. Nearly a quarter of a million people passed through the turnstiles in 1984, and that was without publicity or directional signs of any kind. The need was confirmed, but the question remained what should be done?

A search was launched to locate an architectural firm to design a renovated facility that would serve as Tampa's municipal zoo. After reviewing a number of architects, Design Consortium, the firm that was responsible for the renovation of the Audubon Park Zoo in New Orleans, was finally selected. Their charge was simple but difficult. Design a zoo that would get the existing animals out of their cramped, outdated quarters, and bring a fresh new approach to zoo design that would allow the zoo to remain small enough to be in harmony with the major facility at Busch Gardens.

In conjuction with retaining the firm from New Orleans, the City also decided to hire its first, full time, professional superintendent to oversee the construction and management of Tampa's Zoo. The combination of architect and zoo director would subsequently design a zoo that would hopefully become one of the country's finest, small zoos.

The Zoo project will be constructed in phases with the first phase concentrating on animal species already owned by the Lowry Park Zoo. The Asian area will feature new exhibits for Asian elephants, Bengal tigers, and Himalyan black bears. Other species of animals such as gaur, Bactrian camels, blackbuck, and leopards will also be included in this section. The Primate area will contain chimpanzees, spider monkeys, and macaques that are already in our animal collection. And we will add orangutans, tamarins, lemurs and other primate species that will be located in a heavily planted area with many water moats and waterfalls. The final section in phase one will be a forty-five foot high walk-through aviary that will be divided and will exhibit birds from South America and Asia. Other important phase one features will include a new entrance area with gift shop and food facilities, administrative offices, a new food preparation/ hospital building, and a children's village. Later phases will concentrate on African animals, grasslands of the Americas, and a special section devoted to the wildlife and natural history of the state of Florida. The final phases will include development of a reptile house and an education building. All of these modern facilities and exhibits will be layedout on a twenty-four acre site that boasts plenty of trees and a beautiful city park. It sounds like a wonderful plan. But who will pay for it?

Financing is one of the most critical problems a project such as ours must face. Anyone can dream up a design, but somebody has to pay for it. The price tag for our new facility is going to be over $14 million dollars. Sources of funding of that magnitude are very limited and in our case will come from two sources, municipal and private. The Zoo is fortunate to have the backing of a strong mayor and a supportive city council, and we are fortunate to be in an area thatis experiencing steady growth accompanied by a strong economic climate. As a result, the city was able to refinance some outstanding bonds at a lower rate and realize a savings of over $30 million. Since the Lowry Park Zoo was one of the city's high priority projects we received nearly $6 million along with the commitment of the city to see the project through. The only stipulation was that the rest of the money be raised from private sources; this would be the task of the Lowry Park Zoo Association.

When the question of what to do about the Zoo was settled and an architectural firm was selected to develop the masterplan, the Zoo Association accepted the role of promoting the development of the Zoo and raising the money needed to complete the project. After checking with local fundraising experts, it was quickly realized that the Zoo Association could not raise this money alone. Competition for dollars would be keen and professional help would be needed to accomplish their goal. Since we did not have the facilities or support staff to hire our own development person, a consulting firm would be needed to help accomplish our goals. After a lengthy review process, which included visits to the home offices of the two finalists, the Lowry Park Zoo Association hired the firm of Bentz, Whaley, Flessner & Associates of Minneapolis to do a feasibility study and begin the capital development campaign. When their study was complete, it was determined that even though Tampa does not have a history of philanthropy there is enough money and support in the community to complete the project. One of the more unusual aspects of this project is the fact that even though no private money has been raised the construction is proceeding anyway. The city money is now at work, and the civil phase which includes demolition, underground utilities, roads, parking, and perimeter fencing is complete. Design for the first phase of construction is also complete and should be underway soon. It is anticipated that this unique blend of public and private money will not only speed up the construction but it should make fundraising easier as well. Potential backers will be able to see the commitment in a very real way and will be assured that their contribution will be put to good use.

Though we may be fortunate in Tampa to be in a good economic climate and to have the backing of city government, there may be some applications to other cities as well. One lesson that we have learned is that no one wants to shoulder all the burden. Our city government was willing to help finance and support the Zoo not only because it needed it but because it was popular with the citizens of Tampa. Once local politicians realized that not only was it morally right, but it was a political dream, our support began to increase dramatically. On the other side of the fence, the business community was asking whether the project should go ahead and whether they should support it. Once they saw the commitment of the city and the impressive masterplan, they were quickly sold on the project. Though no money has formally been raised, commitments are being made and an influencial group of individuals has been formed into a campaign cabinet. The money will not be far behind. Another feature that should help insure the success of our project is the relatively small size of our facility. We recognize our role as an urban zoo that will serve the citizens of the Tampa Bay area. We also recognize the fact that we have one of the country's finest zoological collections here in Tampa at Busch Gardens. Therefore, our emphasis will be on small overall size with top quality exhibits and a full range of public services including education, docent programs, volunteer opportunities, and outreach. Our philosophy is that you don't have to be a large zoo to be a good one.

In closing I would say to all who face a similar circumstance, do not be discouraged. The lessons we learned in Tampa are to establish your goals, find a strong base of support and develop your plan. Tampa Parks Department personnel and the Lowry Park Zoo Association knew early on what was needed. They weren't discouraged by lack of funds and seeming indifference in the community. As they forged ahead and picked up momentum, people began to climb onboard until now the zoo is one of the most popular projects in town, one that the citizens of Tampa will be proud of and one that the world community of zoos will also be proud to be associated with.

THEMING CONCESSIONS FOR MARKET APPEAL

Gerry Ward

Concession facilities play an extremely important role in the zoo visiting experience. Facilities that are well designed and well run help to make people feel comfortable with the surroundings. This encourages them to stay longer, so that they become more involved with their visit, incidentally absorbing more of the educational content, and eventually spending more money at the concessions.

Concession design is of paramount importance to a successful food and merchandise program. It must appeal to visitors, be in good taste without suggesting expensiveness, and, if possible, relate in some specific way to the individual zoo.

One design technique that is available to certain zoos is to design the concessions with local character. This naturally appeals to residents, because it makes the zoo part of the familiar environment, as well as to tourists, who will enjoy an extension of the local features which are the main reason for their trip to the area.

An excellent illustration of ways in which a zoo can use local color to enhance visitor services is provided by the San Antonio Zoo. Of course, the City of San Antonio offers some exceptionally attractive features. Its seductive, bi-cultural style prompted Will Rogers to praise San Antonio as one of only four "unique" American cities. And the manner in which the City has succeeded in preserving the unique character of its environment while experiencing comunity-wide growth and progress continues to draw national attention and honors. With more than 785,000 residents, 54% of them Hispanic, San Antonio is the tenth largest U.S. city. It has, however, managed to maintain all of the human, friendly qualities of a small town.

San Antonio is steeped in Spanish/Mexican history, as exemplified by the architecture of the McNay Art Institute, the market place, and the City's most famous landmark, the Alamo. Bright colors abound and the popular, traditional style of music is further evidence of a living present firmly rooted in the past.

If the Alamo is the heart of the City, its soul is the Paseo del Rio or River Walk, and its spirit is the Fiesta - an annual celebration that perpetuates the civic pride and folk traditions of San Antonio. The San Antonio Zoo is another gem in this picturesque, old-world city, and thanks to the efforts of Louis DiSabato it is gaining recognition as one of the great American zoos.

Improvements at the Zoo, like those in the City, are unrushed, well-planned and in keeping with the character of San Antonio. Located at the headwaters of the San Antonio River, adjoining Brackenridge Park, much of the Zoo's recent and future development is centered around a river walk theme. Stone bridges and walls echo the architecture of the City, as does the design of both the Aquarium and the Bird House.

Towering limestone cliffs - vestiges of an old stone quarry - make a spectacular backdrop for some of the exhibits. And where real cliffs are not available, the man-made rockwork is hardly less impressive, as in the Gorilla exhibit, the new Seal/Sea Lion complex, and the soon-to-be-opened Cat Caverns.

The Children's Zoo, which officially opened last year, was themed around a miniature River Boat Ride. Features of the Children's Zoo, all built in reduced scale, include: the Nursery, the Everglades exhibit, the Dessert exhibit, the Education Building, the Animal Arena and the Galapagos Turtle exhibit. The main attraction of the ride is yet to come. This will be a 30,000-gallon shark tank, through which the boat will pass.

In 1979, the concession facilities at San Antonio Zoo were old, unattractive and insufficient to serve the 850,000 annual visitors. Working together with Louis and his staff, a long-range program was developed to meet the required service capacity and bring the feeling of downtown San Antonio to the Zoo.

This is the Weiner Den, a small unit close to the Bear exhibits. Here we made a virtue of necessity, limiting the menu to suit the size of the facility, thus ensuring rapid service and minimizing congestion on the narrow pathway. A landscaped seating area - a feature so important to concessions, yet so often overlooked - was added for comfort and appeal.

Next, the old Snack Bar, half service and half vending, was replaced by a new, larger building: the Crossroads Stand. Since the stand is at a major intersection, signs were installed to face all three visitor approaches.

The Munching Elephant stand was created because there was found to be a shortage of snack facilities. The building was designed for location in the high traffic area by the Elephant exhibit/showground. Its color scheme and lettering are in continuity with the overall plan, but an individual design element was introduced, namely a graphic elephant. The stand features soft ice cream, which is a very popular zoo item.

It gets very hot in the back part of the Zoo, so a small stand, the Oasis at Hippo Springs, was added to feature various thirst quenchers. Here again, the sign is in harmony with all the others, with its own special added detail.

The Honey Bear and Friends Ice Cream Shop (so named by Ernie Rooney) is located at the entrance to the Children's Zoo. It was originally called the "Sweet Shop", but we discovered that visitors did not know what to expect and were not entering. This demonstrates the importance of telling visitors what things are in language they understand. The interior graphics, designed by the Zoo Graphic Department, are in keeping with the theme of the Children's Zoo. As in any walk-in facility, they play an extremely important part in creating the proper ambiance.

The Ice Cream Shop features scooped ice cream and cotton candy. Surprisingly, the addition of scooped ice cream at the Zoo did not infringe on sales of soft ice cream. In fact, overall ice cream sales doubled.

The Main Restaurant was not in good shape. It had only one small sign over the door. The interior colors were uncoordinated and the menu board too busy. The exterior seating area was unshaded and consisted of wooden picnic tables for six persons - two common zoo mistakes.

The interim renovation program created the Lions' Pride. Here the sign is more complex and individualistic, yet nevertheless in continuity with the overall program. Expanded seating areas, defined by Spanish walls, were added to accommodate the facility's greater service capacity. The tables are all four-seaters, selected because the average group of zoo visitors consists of three or four persons. The interim program achieved a quick facelift and general clean-up, plus new menu graphics.

The Lions' Pride will soon be taken down to make way for a new, modern facility, with a walkway and deck out over the river. This will be the first facility in Food Fiesta, a major specialty food and entertainment complex planned for the center of the Zoo.

Turning to the souvenir facilities, the old Gift Shop, although well placed at the exit, was small and lacked appeal. The name, "Zoovenirs", is one that has been used in other zoos but it lacks merchandising appeal. Exterior colors were totally uncoordinated. The signs, too, were uncoordinated as regards both colors and typeface. The old interior layout provided counter service. It lacked color and proper lighting, among other things.

Since the Zoo has a large flamingo colony at the entrance, the expanded shop was given the name "Flamingo Plaza". The new shop blends dark wood with warm Mexican colors, tiled floors, color-coordinated wallpaper and handcrafted ceramic lighting fixtures. The archways add a Spanish flavor, and a cart used for merchandising brings to mind the street vendor of earlier times.

Wooden archways with wrought-iron balustrades divide the space into three separate rooms and continue the Spanish theme. The general merchandise room features gifts, souvenirs and books. An old storage closet was initially converted into a bookshop, featuring books for both adults and children. Since sales were disappointing, especially in the adult category (less than 1% of overall sales), the area was then turned into Hug-A-Zoo, a stuffed toy jungle. Stuffed toy sales have increased substantially with this innovation. Children's books are now featured in freestanding displays, and sales have increased slightly.

The old Zoo exit was moved over onto the side driveway, to allow for expansion of the shop and creation of an apparel room. Here the interior design suggests a Spanish mansion, with stucco walls, high ceiling and bricked arches.

Before renovation, the Souvenir Stand looked more like a fortress than a merchandise outlet. The new stand has an expanded sales area and front glass showcases. The three windows offer three distinct categories of merchandise: hats, T-shirts and toys/souvenirs.

Koala Korner is a small souvenir stand located at the entrance to the Children's Zoo. It is divided into two sections, one over-the-counter and the other self-service. The latter features a limited number of toys and souvenirs, all of which are merchandised on the front counter. This type of stand, where feasible, produces a higher average sale than the normal souvenir stand. The over-the-counter section features gift and apparel items which it is preferable to protect from handling.

Even on the Bear Necessities cart the colors are in keeping with the overall program. This cart features hats and film, two items that sell best from mobile operations.

The Flamingo Plaza Gift Shop will be torn down within the next few years, to allow expansion of the entrance plaza. When that time comes, the existing Monkey House will be renovated and converted for the creation of Mercado Plaza, an exciting new exit complex with 3,000 square feet of retail space, a cafe and a priceless antique carousel.

What has this renovation meant to San Antonio Zoo? First, attendance has grown from 854,000 to just over a million visitors in the past five years, which is proof enough that San Antonio residents appreciate what has been done and now enjoy the Zoo more than ever. Secondly, food and merchandise sales have increased during the same period from $500,000 to $1,505,000. Upon completion of Food Fiesta and Mercado Plaza, sales will certainly go higher still, probably exceeding two million dollars.

What are the lessons to be drawn from the success story of San Antonio Zoo? Briefly:

1. Concession design is as good as the Zoo director or zoological society wants it to be.

2. A good concession program can take years to develop. It is an ongoing process that is constantly undergoing improvement.

3. Today's public is more sophisticated than ever before and expects, or even demands, clean and appealing facilities. People are willing to pay for these amenities.

4. Concessions need an identity, whether the theme is local, regional, geographical, animal-related or a general zoo theme.

5. Build on what you have, then plan for expansion.

Synopsis of the Cry of the Kalahari as presented by the authors, Mark and Delia Owens.

by Jeff Swanagan
Education Director
Columbus Zoo

In January of 1974, armed with a camera, a pair of binoculars, some camping gear, and a change of clothes, Mark and Delia Owens traveled to Africa. They were looking for a pristine place where they could study predators. The place they found turned out to be one of the most remote and forbidding places on earth, the Kalahari Desert.

For seven years, the Owens' endured scorching 50 C (122 F) temperatures, traveling 160 kilometers (100 miles) for fresh water, fighting grass fires, going for six months without seeing other people, and hearing lions sleep outside their tent. As field researchers, they have developed an incredible durability, limitless grit, and immense perserverence. With their doctoral degrees in animal behavior and ecology received from the University of California at Davis as background, their research has revealed several interesting findings:

> Desert lions can live indefinately without water. Kalahari lions have been documented as going as long as two and one-half years without water, living off the fluids of their prey. The previous known record for lions was nine days.
>
> The social organization of Kalahari lions is different from that of lions in East Africa. During periods of severe drought, the lion prides disintegrate, territories are abandoned, and roaming areas are expanded by as much as fifteen times. During the wet season, the prides reform, frequently including unrelated lions from different prides and territories.
>
> Brown hyenas are not solitary wanderers as had been supposed. Unlike spotted hyenas, they are endangered and live in clans. If the clan mother dies, other females and older siblings adopt the offspring.
>
> During their fifth year of study in the Kalahari, the Owens' discovered the second largest wildebeast migration on record. In groups of 40 to 400 individuals, the migrating herd stretched along a vast front of more than 160 kilometers (100 miles). Following a route used only during extreme drought conditions, the wildebeasts were suddenly stopped short. Between them and their destination stood a wire fence stretching more than 800 kilometers (500 miles) across the desert. The Botswana government had installed the barrier to separate domestic cattle from wild animals. The migrating herd then had to move along the fence directly away from the water supplies.

> Tens of thousands of animals died of thirst, hunger, and fatigue. Thousands more died from becoming tangled in the fence. Those animals able to reach the distant watering areas were greeted by bands of poachers with dogs who savagely attacked them for meat and sport. Only a critically small number of herds survived this ordeal. If the drought and slaughter continued, the entire Kalahari antelope population could be destroyed, taking with it the life support for the predators.

In December 1985, Mark and Delia Owens plan to return to the Kalahari camp, which is supported primarily by the Frankfort Zoo, to continue their research and conservation efforts to save one of the few remaining pristine environments. The Owens' have earned membership in an exclusive group of animal behaviorists and conservationists who have been able to earn a living in Africa on their own terms, including George Schaller, Dian Fossey, and Jane Goodall.

THE ZOO AND ITS IMAGE

Gordon Hubbell, D.V.M., Education Director
Metrozoo, Miami, Florida

The zoo and aquarium profession has had a fascinating history - at times colorful and dynamic, at times placid and individualistic, and at other times turbulent and beset by confusion - but we have always been able to band together to overcome adversity when it threatened.

We are once again at a critical point in the growth of our profession, and it is important that we have an understanding of what lies ahead in order that we can make our long range plans. But, in order for us to predict our future, we must understand our past and our present. We may not all agree on our mission in life, but it is better to be working toward a goal than to be floundering about in a sea of indecision. I remember when I first went to work in a zoo many years ago, I asked the zoo director what the function of a zoo was. He couldn't answer me, because, he admitted to me, he didn't know. I was shocked! So I hope that the comments that you hear from the speakers in this session will cause you to make some serious decisions, if you haven't already made them, about your function and your goals in the zoo and aquarium profession.

The fact that we display living animals along with live trees, grasses and shrubs in an educational setting sets us apart from all other cultural institutions. We have been referred to as "Living Museums" and the display of living wild animals to the public is what we are all about. Past surveys have indicated that the primary reason people come to the zoo is for family entertainment, and the animals are what makes the visit unique and interesting and certainly more entertaining.

Twenty years ago, in this profession, there seemed to be an almost eternal race among zoo directors and curators to get the biggest, the rarest, the most, and certainly, the most unique form of any living animal so that one could brag to his colleagues that he had something that no one else had. There were zoos that exhibited great collections of different species of wild cats and every known living species of rattlesnake. Reptile people, bird people, and mammal people all lived in their own little worlds back then. In fact, I know of one zoo where the reptile curator locked the zoo director out of 'his' reptile house.

But, back in the early 70's the zoo and aquarium profession itself was threatened with extinction, and all of this foolishness gradually disappeared. We were close to being strangled by proposed government regulations, and the humaniacs were biting at our heels. We entered into an era of cooperation between all elements of zoo and aquarium management and also between individual institutions. We overcame the threat, and in doing so became more professional, better organized and eventually more scientific in our approach to wildlife management.

ISIS came along' then, SSP. And with these came a renewed interest in getting the rarest and most unusual forms of animals for our captive breeding programs. It seems almost as if we have come full circle. With our constantly improving animal management techniques we are making great strides towards maintaining captive breeding populations of many different species of wildlife. To help us, we now have the IUCN and its SSC and CBSG and our own WCMC with its SSP, and, of course, there is ISIS. We have succeeded with artificial insemination and interspecies embryo transfers. It's enough to boggle the mind of any wildlife enthusiast for it would seem that the possibility of successfully propagating many species in almost any quantity is right at our finger tips.

But, because we have put so much emphasis on captive breeding and have become so scientifically oriented in the management of our zoos and aquariums, we have largely ignored their entertainment appeal. And yet, the entertainment appeal is the main attraction that has brought in our visitors for all these years. Jeanne Segal pointed out to us very graphically last year, that we have always had shows, of one kind or other, associated with most of our institutions. American zoos atarted having animal shows as part of their operations more than 100 years ago, and in recent years oceanariums have expanded this show format until today oceanariums are light years ahead of zoos in presenting tastefully entertaining programs that are educational in nature. In fact, they have created such a concern for marine life that in some cases it's backfired, as there are now organizations that are trying to stop the collecting of such animals as killer whales for displays and shows. Nevertheless, oceanariums have been committed to the entertainment of their visitors ever since they first became popular back in the 1940's.

Zoos have been criticized for their animal rides - elephant rides, camel rides, pony rides, and they have been criticized for their contact areas and traveling zoos. Yet, we have always felt that the ability of our patrons to touch certain animals is an important part of their entertainment experience - besides being a fantastic educational tool. Were it not an educational type of entertainment where facts are being presented about animal life, it may be inappropriate in the zoo and aquarium setting. So, although we are an entertainment center, the entertainment we choose has to be appropriate for the zoological park or aquarium. It is, in almost every instance, educational, and it must never be injurious to the animals. There is always room for other types of tastefully done entertainment in our institutions, such as concerts and home shows, which have little to do with wildlife. Some zoos and aquariums have strayed from a strictly animal oriented theme in order to create more interest and raise additional revenues.

The entertainment feature of our operations goes beyone just having animal shows. We must also provide good service. If our visitors come in and find some of our exhibits closed, dirty walkways, discourteous employees, concession stands closed, bad food, or a drinking fountain that doesn't work, - do you think that they are going to rush back? Our institutions have to be perfectly manicured and carefully cleaned at all times. The walkways have to be edged, the bushes have to be trimmed, the restrooms have to be cleaned. You remember how annoying it is when you go to a movie theater and there is popcorn all over the seat and sticky soda pop all over the floor. You probably won't want to return to that movie theater for quite a while. Well, the same is true of the visitors who come to our zoos and aquariums. We cannot afford to offend our visitors, because we are dependent upon them for our continued existance.

In recent years we have concentrated our efforts on developing captive breeding herds, because we have always felt that the long range propagation of endangered species would eventually save some animals from extinction. But, while we have been doing this we have not capitalized on the more immediate impact that all of these captive breeding programs would have in creating public interest in our institutions and ultimately in wild habitat conservation. The more interest they generate, the more people will visit our institutions, and the more people we will be able to educate about the need to conserve wild habitats. Let's never lose sight of the fact that zoos and aquariums are for people. If we built our exhibits strictly for the animals, we would probably never see most of them. True, they are built to accommodate the animals in the best way that we can, but the animals must be visible to the zoo visitor. We choose the animals we display because they are appealing. They are beautiful in color; have beautiful horns, or they are graceful and spectacular animals. Some may even be big and ugly, but for whatever reason we like them, and more important, the public likes to see them. The same is true of our captive breeding programs. We don't choose animals for captive breeding programs strictly because they are endangered. If we did, our zoos would be filled with Key Largo wood rats and Alabama beach mice as well as tigers and antelope. We choose the species that have the greatest public appeal.

There are parallels in this great Entertainment Industry of which we are a part. For example, let's compare the television profession with the zoo and aquarium profession. Besides its actors, directors and producers, television has its groups of technicians for lighting, sound, and staging, who are an essential part of the overall production. They are the 'nuts and bolts' of television production. They belong to professional organizations within the industry and the business could not function without them.

We have our own technicians in the zoo and aquarium profession, and we call them zookeepers or aquarists. They are our skilled technicians who care for our animals on a daily basis. Besides cleaning the exhibits and feeding the animals, they observe them for signs of ill health or potential problems, and they are the first line of defense in maintaining the health of the zoo animal collection. They are, therefore, the most important link in the zoo or aquarium's preventative medicine program. They also have their own professional association - the AAZK with their own annual conference. They are an indispensible part of the zoo and aquarium profession, for without them we could not function for very long. But, our zookeepers and aquarists must never lose sight of the fact that they are also part of an entertainment attraction. They have a responsibility to have their exhibits cleaned and the animals out on public view whenever the zoo is open. When they are approached by zoo visitors asking them questions about the animals or the location of the nearest bathroom, or concessions stand or exit, they have to be able to deal with these people in a very diplomatic manner. They probably have more direct contact with the general public than any other segment of the zoo and aquarium staff, and their response to a visitor's request may mean the difference between leaving with a positive impression or a negative impression.

Three needs are going to have a major influence on our planning for the future operation of our zoos and aquariums. The first is the need to increase the popularity of our institutions. The humaniacs are back! They are better organized, and there are more of them. And, they pose a real threat to our institutions! Today they are condemning the use of laboratory animals for experimentation - even breaking into labs to steal and release animals. Tomorrow it will be zoos and aquariums, and we must be ready! The humaniac's approach is an emotional one unsupported by scientific fact, and all of our many scientific accomplishments are not going to win the battle against a tide of emotionalism. We have to become so popular with the public that the cries of the humaniacs go unnoticed and public outrage results from their attempts at violent acts.

The second need is for our conservation message to have a greater impact on the visiting public. We must become a louder voice for the cause of wildlife conservation. Our educational programming, our graphics, our press releases, everything that is produced for public consumption must directly or indirectly convey the urgency of the need to conserve wild animals and wild habitats to as many people as possible.

The third is the need to raise additional revenues to cover the operational costs of our institutions. Municipal funding is drying up, and we have to become more self sufficient.

The answer to all of these needs is basically the same - get more people involved with the zoo or aquarium operation - as visitors, supporters and contributors. To accomplish this I offer the following suggestions:

The entertainment factor is going to continue to be the most important thing that lures people to our institutions. Simply being a display of animals is not going to be enough. We must provide a total experience for our visitors. Animated displays, using movies or video, can illustrate behavioral characteristics that a herd of live gazelles sleeping in the shade of a tree in the middle of an exhibit does not demonstrate. Volunteers can be used as stationed interpreters to describe the animals' behavior or allow visitors to touch antlers, horns or hides from the species on exhibit. When reproducing habitats, we can make the visitor feel that he is sharing the habitat with the animals through judicious use of artificial rocks, caves, trees and other vegetation, and even by controlling the temperature and humidity in the public areas of enclosed building exhibits. Also, things like artificially produced thunder storms, wind, snow, surf and fog can be added to make for the total experience.

The addition of spectacular animals (pandas, rhinos, elephants, koalas) will also help boost support. For example, after the National Zoo acquired the pair of giant pandas, their attendance doubled. The koala exhibit at the Cincinnati Zoo also increased their attendance by over 100% during the time that it was there.

All of us cannot afford to build a new animal exhibit every year, and yet we have the ability to acquire new animals on a regular basis through temporary loans from other institutions. Traveling exhibits of koalas and pandas are a healthy sign that zoo managers understand the importance of promoting the entertainment feature of zoos. It also provides us with a means of getting new, unique, crowd pleasing animal exhibits without having to add new expensive buildings.

Exhibits featuring people native to different areas of the world describing and demonstrating their customs can also be popular. We had an "Urban Man" exhibit at Metrozoo last year that was very successful. The actor who portrayed the Urban Man was a highly talented mime, and he put on a very entertaining show. But, besides the entertainment value of this exhibit, it gave us a thought provoking look at ourselves as we bustle through our frantic urban existance. Why can't we do the same with people from different areas of the world and incorporate native villages, native foods and souvenirs where possible? Besides being entertaining it may help improve our own understanding of people from foreign countries.

Our educational programs must be more than just lectures. They must be dynamic, entertaining shows that keep people excited about coming back to the zoo and ultimately excited about saving wild animals and wild habitats. The programs should feature live animals and hands-on artifacts presented by speakers that are trained in the skills of entertaining people of all ages.

Employee training will be one of the keys to the success of our operations in the future. Most of us have employee and volunteer training programs, and they continue to be an effective management tool. However, there should be greater emphasis on the need for proper maintenance of the exhibits and the grounds. And, above all else, employees must receive extensive ongoing training by qualified personnel on how to effectively deal with the public and manage crowds.

Marketing and publicity will be an important part of the future development of our institutions, and marketing on a national level by the AAZPA will be necessary for the continued success of our profession. New animals and new exhibits always make excellent news items. But let's not forget things like animal births and embryo transfers and many of our research programs which we may find are also excellent news items if they are made more available to the news media. All of this means that there has to be a close working relationship between the animal management people and the marketing and publicity people. It's a shame that we have become so specialized in our profession, that we now have concurrent sessions at our annual conferences - some dealing with animal management, some dealing with public relations, when perhaps we should revert to a single main session so that animal management people could hear presentations by public relations and marketing experts in order to learn more about the importance of P.R. in a successful zoo and aquarium ooeration. And conversely P.R. and marketing people could learn from the animal management presentations so they would understand more about the institution that they are trying to promote.

We operate some of the most popular entertainment centers in North America. The sooner we can all accept the idea that we are an important part of the entertainment industry, the easier it will be to get on with our long range planning. For the average working class family, going to the zoo or aquarium should become the "in" thing to do. For those in the higher income brackets, going on a photographic safari or a whale watch led by a zoo or aquarium professional from your own institution should be their "in" thing to do. If we can create enough interest in wildlife, we may have a chance of winning the war against habitat destruction.

I guess that there is always that fear that we may do too good of a job promoting wild habitat conservation and the public will want to close down our institutions. It is a calculated risk. But, the fact remains, if we don't do a better job of preserving our wild habitats, there will be no need for our involved captive breeding programs.

In closing, I would like to leave you with this thought. The key to our future success will depend upon how well we are able to develop the entertainment appeal of our institutions. Remember: our main function is the entertainment of the public; our goal is the conservation of wild animals and wild habitats.

THE ZOO PROFESSIONAL OF THE FUTURE

Charles L. Bieler, Executive Director Emeritus
Zoological Society of San Diego

When I received the call from Dr. Boese asking if I would be willing to do a short spot on the program at the Conference this year, and he gave me the subject of the zoo professional in the 90's and into the 21st century, it hit me as quite intriguing. I thought maybe it paralleled a speech I always toyed with giving--something along the line of, "Should we trade zoo directors instead of zoo animals?"

Actually, I gave a lot of thought to the subject matter, and with some sincerely mixed emotions as to what is going to be expected of our profession in the years ahead.

This led me back to one of the experiences I had early in my career as the director in San Diego when the Wild Animal Park was still in its infancy and we had a business meeting at the Park. We talked about adding additional food stands to get some more revenue to pay bills. I was standing out near the Bird of Prey amphitheater, and I mentioned to the trustee who was with me that we were going to put a food stand right 'over there.'" He said, "What do you mean you're going to put it right over there?" And I said, "Well, we'll put it along that trail over there." He said, "I don't want to hear 'over there'. Tell me exactly where you're going to put it." I said, "For Heaven's sake, Charlie Schroeder stood right on this hill and said, 'I'm going to put East Africa here, the parking lot there, South Africa there, and Nairobi Village here' and you bought it all. Now I have to give the exact location of a food stand!"

Bizarre as this might seem, I think it is very relevant to the changes in our profession of today in that we are being asked for more things, more specifics, greater accountability, and greater responsibility. I don't believe there is anybody in this room who will deny that our profession has changed dramatically over the past 10 or 15 years. How many of you in your own community have heard people say, "Oh, you work at the Zoo. Isn't that wonderful, and isn't it great fun to be working with all those animals!"? And you sit back and think, my Heavens, when is the last time I really went out and spent time with the collection and devoted myself to it like I should have?

Going back again and looking at the past...Belle Benchley wrote a book, My Friends, the Apes, and one called Animal Babies. Ted Reed in his retirement is doing his memoirs on Politicians and Other SOBs I've Known. (SOB, that's surgeons of bureaucracy.)

Let's look a little more at the past. (And I do believe that it's very important that you look at the past to analyze the present and to forecast for the future.) Can you envision going back to the 40's when Belle Benchley was director of the San Diego Zoo. She is sitting at her desk and K. C. Lint, bird curator, walks in to tell her that our government has confiscated some parrots that were illegally brought into the country and they're ours for the asking. Then take a similar situation today. Bill Conway is sitting at his desk at the Bronx, and

Don Bruning walks in to tell him that the U. S. Customs Clearinghouse has confiscated a shipment of CITES 1 birds that have been illegally smuggled into the country and in a 30-day quarantine because of Newcastle's disease, and he's concerned that they don't fall into the collection management program for the Zoological Society of New York. So, he is going to call the chairman of the AAZPA Clearinghouse and check it out with all the species coordinators for the SSP program to see what the proper disposition is for this collection of endangered species. Times have changed!

Times have changed even to the language we are speaking. Our predecessors would have gone to the personnel and employment department. Today we go to our human resources department. We used to talk about fund raising; now it's development. A lot of us used to know when secretaries typed things on typewriters, and now administrative assistants are inputting them on word processors.

But even more specifically within our own profession, we used to talk about postage stamp collections with many species, and now it's mixed exhibits and breeding groups. It used to be: send me 1.1 Asian lions, and now you want an unrelated breeding pair. They used to have I.D. signs in the zoo; now they have comprehensive interpretive programs. We used to talk about the plants--which have now become the botanical collection. A hundred-thousand-dollar exhibit is now a ten-million-dollar bioclimatic habitat. Animal records are now International Species Inventory Systems. Breeding programs are International Species Survival Plans. We used to have a five-year economic forecast, which is now a long-range strategic plan. It used to be time-and-motion studies; it's now productivity programs. And we used to go to staff meetings; now we are involved in participative management.

Further analysis of this change in direction, change in dialogue, just points out that the changes are occurring at a much more rapid pace than they did in the past. With this in mind, you look at what it's going to take to be a zoo professional in the future. It just guarantees that the makeup of zoo pros is going to have to change as dramatically as our language and way of living are changing. We are no longer going to see the hobbyists as we have in the past--the Larry Klauber or even the Dr. Harry Wegeforth. It really is going to be like the professions of tradition--law, medicine, teaching--in that there are going to be definitive criteria to live by, and the standards to be met will affect our very civilization far into the decades in the future.

I think, unlike the attorney or the accountant, or perhaps even the physician, we have a thread that will carry us into the future. That will be a common goal that will make our profession a lot more acceptable and a lot more rewarding than those that will parallel us. We do have a chance to protect something that is vital to our heritage--to provide exotic wildlife for future generations to see, enjoy and learn from and, hopefully, for natural wild habitats to contain.

I believe this thread of a common goal is going to be the focus for our profession in the years ahead. It leads me to believe that the focus of the superstar in the profession will be in a different vein.

I listened to Dr. Rabb's presentation on Monday on the need for a commitment by our institutions to our conservation goal. The fear of failing to commit to this goal and the consequences of not supporting what we know is right, versus the fear of an inability to get the funds to support conservation programs...ladies and gentlemen, I understand that fear, and it's real and it's valid.

But, please allow me to set a possible scenario for the 21st century, say, for 2005 A. D.:

1. The President of the U. S. is a 43-year-old woman (who, in 1985, at the present time, is completing her Ph.D. at Ohio State in communications, and is attending the AAZPA conference in Columbus as a student).

2. We have world peace.

3. The AAZPA has 25,000 members, but still has only 116 institutional members. Our annual meeting was held on the World Ship Survive. It used to be the Love Boat, but it was bought by Sea World for its education department to use for international programs on conservation.

4. Bob Wagner is still executive director of the AAZPA, but has announced he will only serve for 10 more years, and we should start looking for a successor.

5. The AAZPA Board appropriated $3 million from its conservation fund for worldwide programs in field conservation. ISIS is still running at a $15,000 deficit, and the Board approved $2,000 in travel for Uly Seal and his nurse to attend the captive breeding specialist group meeting at the preserve for Przewalski's wild horses in Outer Mongolia.

6. In its sixth meeting of the year, the Species Survival Plan management board authorized and funded 17 animal exchanges for 14 species to effect the continued propagation of these species. They also approved the release of the seventh pair of California condors at the California Condor Way Station in the Santa Barbara Mountains. (This is the former Ronald Reagan ranch.)

7. The Bean Award for mammals went to the okapi zoo consortium for the successful birth of 50 okapis through embryo transplant.

8. Jack Hanna, recipient of the Academy Award for best actor in the movie based on Dr. Seuss's book, "If I Ran the Zoo," was presented with the Marlin Perkins Award.

9. In her address at the final banquet at the AAZPA conference, the President of the United States complimented the Association for its

farsightedness and unselfish commitment to the cause of conservation. She cited the intelligence shown in the planning, the cooperation, the management skills and the dedication to the cause that led to the development of the plan for saving somewhere between 25 and 30 percent of the wildlife of the world from extinction. In closing, she said that a greater challenge lies ahead.

Indeed, there are many challenges for the future, but the opportunities are unlimited. We are fortunate in that we have bright, aggressive, young people joining our profession today. They want to be a part of it. We must get them involved and allow them to grow, because they are going to be the future, and they will suffer the consequences if we fail.

The Species Survival Plan (SSP) and the Lowland Gorilla

A Special Report from the SSP Gorilla Propagation Group

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In January 1915, Bronx Zoo director William Hornaday wrote, "There is not the slightest reason to hope that an adult gorilla, either male or female, ever will be seen living in a zoological park or garden."

On February 6 1985, there were about 253 lowland gorillas (*Gorilla g. gorilla*) in 47 US and Canadian Zoos, 118 males and 135 females. Of these, 123 were captive bred, in fact 8 had been born in 1984. Although gorilla importation from nature has stopped, at least seven zoos had recently built or were building new facilities for gorillas. Thus, prospects for the lowland gorilla's North American population seemed bright, its future secure. However, investigations by the Gorilla SSP Group over the past two years paint a different picture.

The North American gorilla population is growing older, its reproduction is poor, and zoo cooperation and research to overcome reproductive problems is inadequate. The population is likely to become extinct unless these trends are reversed.

Gorilla SSP initiated

In 1983, an SSP Gorilla Propagation Group was established to collectively manage the North American population in its own best interests. Memoranda of Participation were signed by 44 AAZPA institutions caring for gorillas. Lester Fisher was elected chairman of the new Propagation Group and nine members were elected by and from Participating Institutions to assist him. Together, this group is attempting to aid and coordinate propagation in institutions holding gorillas and develop an SSP Masterplan to assure their survival. The gorilla's exceptional interest makes a discussion of its status a means of typifying the challenge of SSP programs as a whole.

The lowland gorilla in nature

A 1982 Gabon study estimated that country's wild gorilla population at approximately 35,000 (Tutin and Fernandez,1983), although the patchiness typical of large mammal distribution makes such a figure difficult to confirm. There are additional populations in eight other African nations; especially the Central African Republic, Cameroon and Zaire. However, throughout its range, habitat loss is rapid and in some places gorillas are killed for food.

Future importation

Unhappily, many gorillas were killed by animal collectors for zoos during the heyday of gorilla importation in the 1950s and early 1960s. Often, several members of a family were shot in order to obtain their young. Although some animals were acquired from locals who had killed their parents for crop-raiding, it is likely that natives made special efforts to kill crop-raiders with babies that could be sold. Few serious attempts have been made to develop humane methods of obtaining wild born youngsters without injuring other members of their families.

Despite the gorilla's decline in nature, zoo biologists can find little justification for further importations in view of the fact that there are about 550 gorillas already in captivity with a death rate that exceeds their birth rate (Beck,1985). There is growing uncertainty that zoos can establish the species securely, much less provide a reservoir for future reintroduction or long-term preservation. Except for a few, individual, exceptions, it is no longer possible to anticipate gorilla importations from nature for US zoos.

How long do zoo gorillas live and breed?

How long do captive gorillas live? How long is their reproductive life? With the death of Philadelphia's Massa at 53, the oldest living North American gorilla is 46 year-old Carolyn at the Bronx Zoo. There are 32 gorillas aged 27 years or older; 156 of from 8 to 26; and 69 which are 7 years old or younger (Figure 1.).

Gorilla males have reproduced as early as 7 and as late as 24, females from 7 to 28. However, the vast majority of babies are born to male parents between 11 and 22 and females between 8 and 22 (Figure 2.) Thus, we can consider the age of sexual maturity of females to be 8 and males 11.

Presently, many breeders are entering their middle-twenties and some of these may continue to breed for a while. Nevertheless, the Propagation Group is fearful that animals past their early twenties can not be counted upon in the breeding population. About one-third of all North American gorillas is 21 years old or older. Even if there were no deaths in the next seven years, we would almost surely have fewer animals of breeding age in 1992 than we do today.

Non-reproduction

Which animals are breeding and which are not and why not? These are obvious questions but we have more guesses than answers. There are now about 68 living gorillas 12 years old or older which have never bred; forty-seven are 17 or more. We lack the data required to identify those animals which may have bred once or twice and stopped because of disease or social problems. And we can not yet report how many females are having problems of tubal patency or how many males are aspermic. SSP advisors Kenneth Gould of Yerkes and Bill Lasley of San Diego suggest that very few non-reproductive females have ovarian problems. Where disease prevents conception, it usually resides "from the ovaries down;" nor is the diagnosis of "sterile" males easy. In gorillas, spermatogenesis is irregular and some individuals which could be adjudged sterile on the basis of sperm evaluation, subsequently become breeders-- usually in a new social group, in better facilities and with a change of diet. The critical physiological basis for reproductive failure in gorillas is, to say the least, inadequately studied.

Wild-born parents vs. captive-born parents

Naturally, the vast majority of gorillas born in this country have been the progeny of wild born parents but it is not too soon to be apprehensive about the reproductive performance of these captive-bred animals. As of February, only five captive-born males and 14 captive-born females have reproduced from the 10 living captive born males 11 or older and 31 females 8 or older.

If there is a clear indication of trend, it is the general one, also true of wild born animals, that fewer males reproduce successfully than females. It seems clear that males are stimulated to breed by the presence of three or four females in estrus, even males with a questionable early reproductive history. But we do not yet know how many non-reproductive animals are not breeding because of behavioral problems, perhaps resulting from inadequate rearing techniques.

Rearing young gorillas

On the basis of subsequent behavior, the Propagation Group believes that where infants can not be mother-reared, rearing in peer groups is the method of choice--although there is no advantage to putting infants together before 10-12 months. The results of hand-rearing vary so much with the individual animal that they are not predictable, and we need clarification of which methods of hand-rearing are best.

Mother-rearing is preferable and its importance in the development of parental competency is thought to be large. Nevertheless, Yerkes' Ronald Nadler suggests (1983) that, during the next few critical years in the faltering gorilla population's struggle to grow and survive, even those zoos successful with mother-rearing may wish to take the baby away at 1.5 to 2.0 years and rebreed the female so as to build-up gorilla numbers more rapidly and provide for as many reproductive partners as possible in the future. The Propagation Group does not yet have enough evidence to embrace this idea but it is thought that the period wherein mother-rearing is most critical to social and parental development is up to the 1.5-2.0 year point. Certainly, after 1.5 years of age, no baby should be kept alone without others of its species.

Even when we do breed gorillas, we have lost 32.5% of all infants in their first year; a figure which has not significantly improved over the years (Seal,et al,1985). In 1984, almost as many gorillas died in US zoos (11) as were born (13). Unfortunately, the mortality of mother-reared infants (40%) has been nearly twice that of hand-reared babies (22%) (Kiser,1981).

Where are they breeding?

Where are gorillas breeding successfully? From January 1980 through 6 February 1985, the 47 NA collections produced 52 babies that were still alive in February 1985. Fifty-eight percent of these births (30) occurred in the five collections with ten or more animals, 42% in the remaining 42 smaller collections. Thirty of the 47 North American collections have produced no young whatsoever, that were still alive in February 1985, during the five-year period.

Among the 85 animals housed in the five larger collections (Lincoln Park, Yerkes, Cincinnati, Bronx and Columbus), were 50 animals 8 to 26 years old, essentially the reported reproductive life span of the species. In contrast, the remaining 42 smaller collections housing 168 gorillas had 106 aged from 8 through 26, yet produced but 22 youngsters. Thus the number of animals aged 8-26 required to produce one baby over 5 years still alive in February was 1.66 in the larger collections but 4.82 in the smaller collections. At this time, 4 NA gorillas live alone; 24 in collections of 2; and 88 in collections housing 5 or less.

Not in pairs

Gorillas are not pair-bonding animals. In nature, most live in troops dominated by one breeding male from which young females emigrate to breed while young males try to stay and eventually take over their natal groups. Sibling incompatibility may be at the bottom of breeding failures in small groups of gorillas raised together; emigration and immigration are the norm in nature (Schaller, 1963; Harcourt, 1978). There are always more sexually mature females than males in normal gorilla society and the stimulation of social interchange and new partners is highly significant. It is especially important in captivity for females to be able to determine the timing of copulation and to be able to get away from the males (Nadler, 1984). "Husband and wife" gorilla situations usually result in social stress, probably in sexual boredom, and certainly in the inability of females to limit attempted copulation to periods of receptivity and to support each other in interactions with the powerful males.

Considering the entire world population of captive gorillas, only 16% of males living in pairs are breeding, whereas 63% of males living in groups of at least three specimens have bred (Kirschshofer, 1982).

2/2 plus?

Because the reproductive performance of gorillas kept in pairs compares so unfavorably with that of larger groupings, the Propagation Group has recommended that zoos participating in the SSP accomodate a minimum of two sexually mature males and two sexually mature females with additional space for young. The intent is for Participating Institutions to have sufficient numbers of sexually mature animals and space to be able to provide for a greater variety of social and sexual partners.

Relocation

Improved understanding of the need to provide social stimulation, reduce social stresses and to alleviate social and sexual boredom as well as to combine experienced with inexperienced breeders has now resulted in many thoughtful relocations of individual animals. The results have been rewarding.

In 1984, Harry Peachey documented twenty-one moves which had resulted in new breedings. The Propagation Group believes that at least 50% of all moves of sexually mature animals from zoo to zoo have resulted in births within 18 months. Animals subject to copulatory failure are particularly likely to be responsive to a move. Only one animal has been lost following a move--after a period of five months for unrelated reasons.

The happy results of gorilla moving should guarantee zoo cooperation with the relocation recommendations of Dr.Fisher's SSP Group. Therefore, during the 1984 Propagation Group meeting, recommendations were made for shipping 30 gorillas between 32 zoos. The majority of recommendations have been ignored.

Excuses

What possible excuse can there be for the failure of so-called "Participating Institutions" to participate? It seems that many gorillas are individually popular in their communities and that the need for relocation is viewed as an embarassment, a reflection upon the quality of a zoo. There is no answer to this problem other than education, but there is a difference in importance between the factor of embarassment and those of poor care, sterility and extinction.

The gorilla commitment

Do gorilla requirements for space and social interchange mean that zoos unable to make a large commitment to them can not be of aid? Not entirely. Help is needed for the rearing of youngsters in peer groups and space for animals which can not breed. Such animals can be good exhibits and the housing of young provides a great service to gorilla propagation.

In any event, zoos which have not already made a large commitment to gorilla propagation should carefully think over their other responsibilities. More collections are needed which can house large groups, no more are needed which can house only pairs. By now, it must be painfully clear that zoos able to house only singles or pairs which have non-reproductive animals still in their reproductive years should make these animals available to collections with larger and better facilities and concentrate their own efforts on the scores of other needy species.

Besides, a commitment to gorillas must become more than one of space and numbers. It must include a willingness to undertake research.

Research

Often, we are unable to distinguish between infertility and lack of reproduction. Usually, we do not have sufficient information to determine which problems are best approached physiologically and which behaviorally. Invariably, we do not know enough about individual animals. And time is growing short.

A first need is to establish a better data base by evaluating each and every animal clinically and behaviorally, beginning with those which are not reproducing. We must bring together all the information we can on gorilla reproductive failure; respond to the SSP's questionnaires. It is essential that we gain an understanding of male and female physiological infertility, of behavioral incompatibilty and reproductive incompetence and of environmental influences. Until this information is in hand, the SSP will be largely limited to the tool of relocation in its efforts to help.

We need to know more of general health factors, especially diet and gastro-intestinal disease. Although a genetic masterplan is essential, its development is more urgent where we deal with a species with fewer founders, most of whose members can be made to breed. Then, we will have to try to equalize the contributions of the founders. Now, we may have to use a few exceptionally potent males as studs.

Every effort should be made to obtain and bank the sperm of fertile males now entering their final reproductive years. Indeed, advancing cryobiology, artificial insemination and embryo transfer must be a major area of concentration as we try to bring non-reproductive animals into the breeding population.

Individual institutions--Toledo, Columbus, San Diego, Cincinnati, Memphis, Yerkes, Bronx and others are attacking "the gorilla problem" piecemeal but there is no overall research strategy. Two have been proposed to the Gorilla SSP; the first by Bill Lasley and various associates and the second by Joe Erwin. They differ greatly in detail but agree in the need to undertake a coordinated approach.

Recommendations

Assuring the survival of gorillas in our zoos will require an extraordinary commitment, one whose complexity will demand a painful degree of altruism and public education, but the prospect of losing gorillas is not acceptable. The Propagation Group's deliberations can be summarized in six critical recommendations and three searching questions for the holders of gorillas.

First, the recommendations:

1. Participating Institutions must follow SSP relocation recommendations unless new information provided to the Propagation Group results in SSP revisions and no gorillas should be relocated without the approval of the Propagation Group.
2. The breeding potential of all reproductively-active proven breeders must be maximized through the provision of an optimum number of reproductive partners in adequate facilities.
3. All animals with breeding potential must immediately be placed into breeding situations. Zoos unable to sustain at least 2 male and 2 female sexually mature gorillas and their young should make their animals with reproductive potential available to the SSP for relocation in more appropriate facilities until such time as their accomodations are improved.

4. All non-reproducing females from 8-26, males from 11-26 must be physiologically evaluated.
5. All hand-reared gorilla youngsters must be placed within appropriate peer groups by the time they are 18 months old. At the present time, it is thought that such groups should include five or more youngsters, if possible.
6. Participating Institutions must respond to calls for data in a timely fashion and help to support SSP research where possible.

Now, the questions:

1. Should your zoo build a new gorilla exhibit?
2. Can your zoo afford to comply with the Propagation Groups's recommendations? Can it afford not to?
3. What do you think will be the effect upon zoos, upon your zoo, if we lose gorillas?

Among all the institutions created by man, only the zoo attempts to care for, and to sustain for the future, life's fragile flame in species that are losing their homes in nature. Despite all their overt and important educational and recreational services, zoos have no higher public purpose. And if they fail, they will have no future purpose.

Of course, Hornaday was wrong when he predicted that adult gorillas would not be seen in zoos--but perhaps only in his timing. He simply spoke too soon. Zoos with gorillas must work together now, before it is too late, and try to save the North American gorilla for the future.

Data base for this report.

Most of this summary has been developed from information compiled and distributed by U.S.Seal and T. Foose to the SSP Gorilla Propagation Group using reports to the International Species Inventory System. Interpolations in this paper are intended to indicate trends. Limitations of the data, which do not permit knowing under what conditions or in what social combinations individual gorillas have been kept or died, restrict the usefulness of some kinds of analysis.

Acknowledgements

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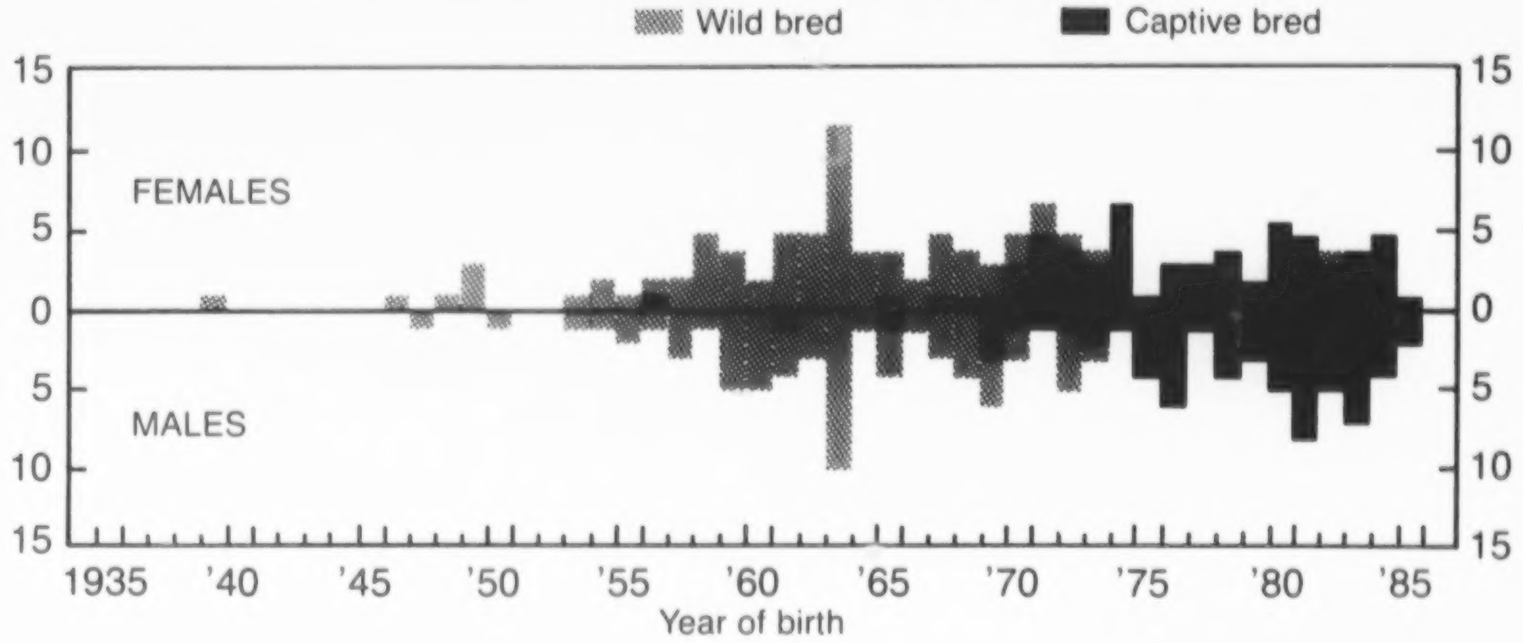
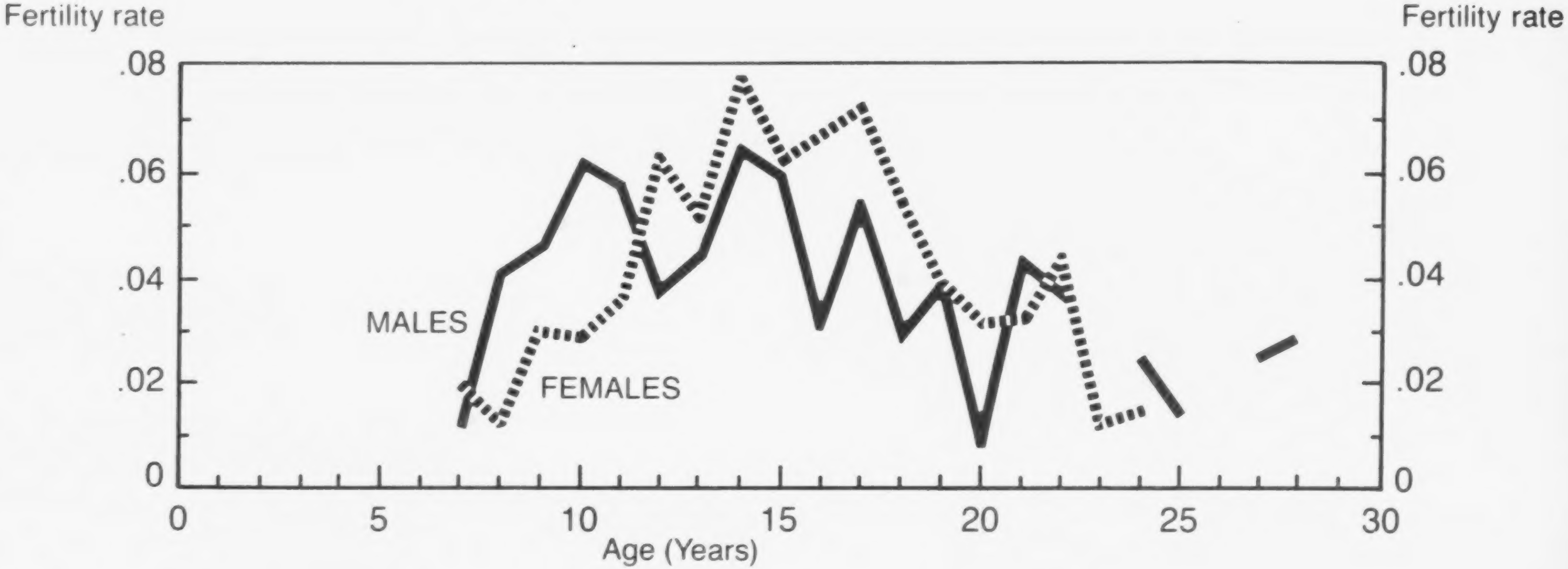
Figure 1 | North American living gorillas as of 6 February 1985



There were 253 lowland gorillas *(Gorilla g. gorilla)* living in North American Zoos on 6 February 1985; 118 males 135 females. There were 59 wild born males and 71 wild born females, 59 captive born males and 64 captive born females.

Figure 2 **Age-specific fertility in gorillas for census years 1975 to 1985**



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The Design & Production of the New England Aquarium's Caribbean Coral Reef Exhibit

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HISTORY OF THE EXHIBIT

The New England Aquarium opened its unique and landmark facility in 1968. The building was designed by Cambridge Seven Associates (Peter Chermeyeff, Principal) the firm's first major building.

The centerpiece of this exciting new facility is the subject of this paper. Architecturally referred to as the "Giant Ocean Tank", or the "G.O.T.", the tank measures 24' (7.3 m) high from its base and 40' (12.2 m) in diameter. The public approach to this exhibit is from several exciting perspectives. (Figure 1.)

As the visitor enters the building, one gets the overall impression from the first level where the full, four story height is viewed. This view sets the stage for all visitors to the Aquarium since the central structure (the GOT) is always in sight from any part of the building. It becomes one's orientation as one moves about the building, up ramps, across bridges, through galleries, and finally encounters the GOT exhibit at close view. This is at the "viewing ring" on the fourth level, where the 187,000 gallon exhibit is seen from above the water level.

The public then makes its way from the third level to first level via a viewing ramp that gently spirals down around the outside of the tank. The descent consists of two full 360 degree turns past some 52 viewing windows. The original in-tank centerpiece was a three story massive form of indistinguishable "coral substrate" with several horizontal penetrations. This mass was placed dead center in the tank with an equal channel of water from window to center piece. An impressive collection of pelagic fishes was the focus of the original exhibit..

THE DESIGN PREMISE FOR THE NEW REEF

After thirteen years since it opened, staff began to talk about a new exhibit for this important part of the building. In 1981 plans began with John Prescott, Executive Director; Lou Garibaldi, Curator; Dr. Robert Wolff, Director of Education and myself as Director of Design. This planning group decided on a Caribbean coral reef community and hoped to achieve a dynamic exhibit through the development of more complex and realistic reef substrate form. The first goal was to create a coral habitat which would provide intricate hiding places for the smaller, more colorful fish. Big and small fish could then be exhibited together. The second goal was to describe as many distinct and different coral habitats as possible from the reef crest to a simulated depth of 80'+ (24.4 m). The third goal was to move the coral substratum from off center in the tank to create as wide a variety of views as possible from the 52 viewing windows. (Figure 2.)

THE DESIGN PROCESS

The first phase of the design process was to build a model of the Giant Ocean Tank from the original architectural drawings. A critical step was to duplicate as accurately as possible the massive concrete two and a half story armature lying under the foam and fiberglass skin of the first reef form. A few key field measurements were made by penetrating and probing the outer foam to find the concrete structure underneath and marking measurements to specific window frames. This was necessary to compare the architectural drawings with the as built conditions. It would be well over a year's worth of work sculpting the new form and committing a portion of it to hard fiberglass before we could begin to dismantle the old reef and truly confirm these measurements.

Once the structural model of the armature was complete at 1/8 scale, it was inserted into a waterproof model of the Giant Ocean Tank. As the new reef form was sculpted in styrofoam over the model armature, it was periodically checked and analyzed by the design group. The focus here was to determine the overall architectural massing of the reef. Taken into account was the visual distortion of viewing the exhibit through thick glass and water. The cone of vision after refraction is reduce from 180 degrees to 42 degrees.

This phase was a very important part of the new reef design process. It was here that we established the dramatic (almost kinetic) changes in the reef form as the public views it through the film-like sequence of 52 windows. (Figure 3.) As one walks from the reef crest down around the reef form, making the two 360 degree spirals to the bottom, the form should be changing all the time. The reef is close to you, far away from you, caves cut through the form, pieces of the reef coming virtually up to the window frames. There is a sense of filling, a sense of emptyness, a sense of foreground with great coral detail, a sense of background. Vertical barriers interrupt the current flow to create eddys and variations in swimming behavior. Several vertical penetrations were made purposefully to introduce dramatic lighting effects.

The final sign-off on this phase of design was to get our exhibit divers to imagine swimming through and around this new form. Agreement could not be reached until all could see it on a larger scale and with the important coral detail.

The next model was quarter scale (3" = 1') (25 cm = 1 m) and for the next six months this 7' (2.13 m) high model was the focus of lighting designers, educators, structural engineers, diver aquarists, coral experts, photographers, TV crews, AD agency staff, fund raisers, and potential benefactors. The greatest attention was given to the placement of coral. At this point the project took on Dr. Les Kaufman as consultant to help us select and place corals to create the full spectrum of environments on a single Caribbean reef.

Now the model began to take on more clearly the special habitat characteristics of the five different depth zones. If you look at a cross section a typical reef (Figure 4.) from the shallow depths of the reef crest to depths of the wall (80' to 100') (24.4 m to 30.5 m) and picture this linear section as being rolled up and inserted in a tube, you should have a pretty good idea of how this exhibit works.

At the uppermost part of the exhibit the shallow reef crest zone is dominated by golden brown fire coral, Millepora complanata, and brain coral, Diploria sp. As one begins to decend the spiral, dense forests of elkhorn, Acropora palmata appear. These formations cantilever outward some 7' (2.13 m) into open water.

The next zone is referred to as the mixed zone, where the distribution of corals is very even with no one species outnumbering any other. Star coral, Montastrea annularis, and lettuce coral, Agaricia agaricites, are seen here at a simulated depth range of 20' (6.1 m) to 40'(12.4 m), along with brain, and staghorn corals. The third zone, a large open area of sand, is referred to as the reef terrace. This open area provides landing and resting spots for the shark and turtle collection. This area represents a simulated depth range between 40' (12.4 m) to 60' (18.3 m).

The fourth zone duplicates conditions found in the 60' (18.3 m) to 80' (24.4 m) depth range. These walls are covered with colorful encrusting sponges, overlapping plate-like growths of star corals, Monastrea annularis, and large purple and ocure tube sponges, Verengia lacunosa and V. fistularis. This area is called the escarpment and it features a giant barrel sponge, Zestospongia muta, large enough for a diver or a fairly large community of fish to hide in.

The last zone at the bottom of the exhibit is viewed through windows numbered 49 through 52. This area is called the wall and simulates a depth of 80' (24.4 m) plus. Here one encounters several penetrations through the reef both horizontally and vertically. The results are most dramatic with a wide variety of light conditions that help create the feeling of depth and great inner space.

PRODUCTION PROCESS

While this larger scale model began to take shape, the process of coral and sponge acquisition began. For those special pieces that could not be obtained through collections, the staff began the slow process of sculpting feature pieces such as the 4' (1.2 m) diameter brain coral and the 4' (1.2 m) high barrel sponge. Aquarium Exhibit Preparator, Peter Brady, was in charge of the coral reproduction for the project. Over 150 molds were prepared and up to 1,500 individual pieces were cast in polyester resin and painted. A total of some 175 branches of elkhorn coral were produced and assembled into 23 seperate "trees".

The coral reproduction would take almost two years at the aquariums exhibit workshop. Next door, in the Design Office, Chuck Beier coordinated input from all departments while overseeing the deisgn of exhibit furniture and graphic support. Meanwhile, a second work space was required to begin the sculpting of the four story high, coral reef. A large pier warehouse across the harbor in East Boston was secured. The plotting out and scaling up this this massive structure in block styrofoam began under the direction of David Baskin.

Over the next few months this mass of foam would be rendered into final form with the most curious array of sculpting tools imagined. Puffs of tiny white styrofoam beads would explode into the air with the swipe of a claw from a hammer. Meanwhile chain saws, oversized cheese graters and crow bars would chomp away at this very maleable material.

Now that the project had two worksite locations, one for coral and one for the substrate form, the management of the project came under the direction of Eric Carlson. Eric had the task of setting up a third location to do the actual fiberglass chop gun work on each of the section of the reef.

The completed four story foam structure (Figure 5.) was sectioned, numbered and cut up into 104 pieces. These pieces were first given a barrier coat of latex and then fiberglassed to an approximate 1/4" wall thickness. A final textured coating was applied before evacuating the styrofoam backing. The finished pieces were numbered to correspond with their original styrofoam piece and ready for installation in the Aquarium.

THE INSTALLATION PROCESS

The final production sight for this project was stage center at the Aquarium...the Giant Ocean Tank. Preparation for this final installation phase came under the direction of Mr.John Bisbee. Here began the complex process of preparing the breakdown of the old exhibit and installing the new one. Animals were removed, the tank drained and the messy process of dismantling the old reef began. Car loads of urethane foam and fiberglass chunks were torn away from the central concrete armature along with several tons of pig iron that was placed intregrally with the foam to prevent over bouyancy conditions.

The old reef on the left (Figure 6.) displaced water, the new reef structure was designed to fit around the original concrete armature with the water circulation flowing both inside and outside of the hollow substrate centerpiece.

Total weight of the exhibit would be increased because of additional water and less displacement. Structural engineers were called in to analyze the load bearing effects of the new hollow reef design. Ultimately, every component being permanently affixed into the exhibit had to be weighed and measured for its new weight and displacement qualities.

Over an intense six months period, Aquarium exhibit staff worked in public view in the tight confines of the 4 story high exhibit. Special equipment was put in place to exhaust the highly volatile and very noxious fumes. The wearing of face masks, protective clothing and review of safety check lists for handling these tough materials was critical. Careful measurements of toxic fumes and airborn particulates were taken at several times each day. At various stages of the project the site looked like some kind of theater set for an M/TV video piece. With stainless steel bolts, the 104 fiberglass sections were lowered into the tank and locked into place. Different crews worked in carefully staged time periods, one team addressed the blending of all the seams to match the color and texture of the panels while others began the meticulous process of attaching the coral.

After the last piece of coral was attached and the use of fiberglass resin had ended, an important air curing time of about one week was necessary. Upon filling the tank, careful water quality checks monitored the exhibit for the remaining week before introducing the animal collection.

From the beginning of the planning process to the final opening of the exhibit a busy three year period had passed. The exhibit opened to the public in July of 1984, three months off schedule, four job captains later with Mr. Steve Lenox spiriting the very pressured last month of installation. Some 14 tons of fiberglass exhibitry was installed. An impressive collection of over 1000 specimens was put together and introduced to the new exhibit by our Curator of Fishes and Mammals, Mr. Paul Sieswerda. Total cost for the project which included interpretive graphics was $710,000.

The year following the opening of this exhibit from June 1984 to July 1985 showed record attendance of 1,134,000 visitors. Numbers like this had not been seen since the original opening of the building in 1968. That's an increase of some 211,000 visitors over the previous year. Visitor time spent with this exhibit more than doubled.

The benefits of this exhibit project are numerous. First, from an educational point of view it is most dynamic to see a full community of fish species interacting together and exhibiting the kinds of behaviors seen in the wild. Paul Sieswerda's paper, which follows mine, will discuss and focus on these animal behaviors.

Second, it is of great importance to the staff to be able to mount such a large scale Aquarium exhibit on a do-it-yourself basis.

This exhibit involved the full range of Aquarium staff talent and called on new inter-departmental relationships and avenues of cooperation.

Finally, it is most satisfying to be able to share the New England Aquarium's technical experience with our colleagues and other institutions.

The Aquarium's Programs and Exhibits Division has a full range of design and production capabilities which we are willing to share with you on a specific project basis.

REFERENCES

Brady, Peter, 1985. "Just Like The Real Thing: Artificial Corals and Rockwork in Aquarium Exhibits". AAZPA Regional Proceedings, 492-494.

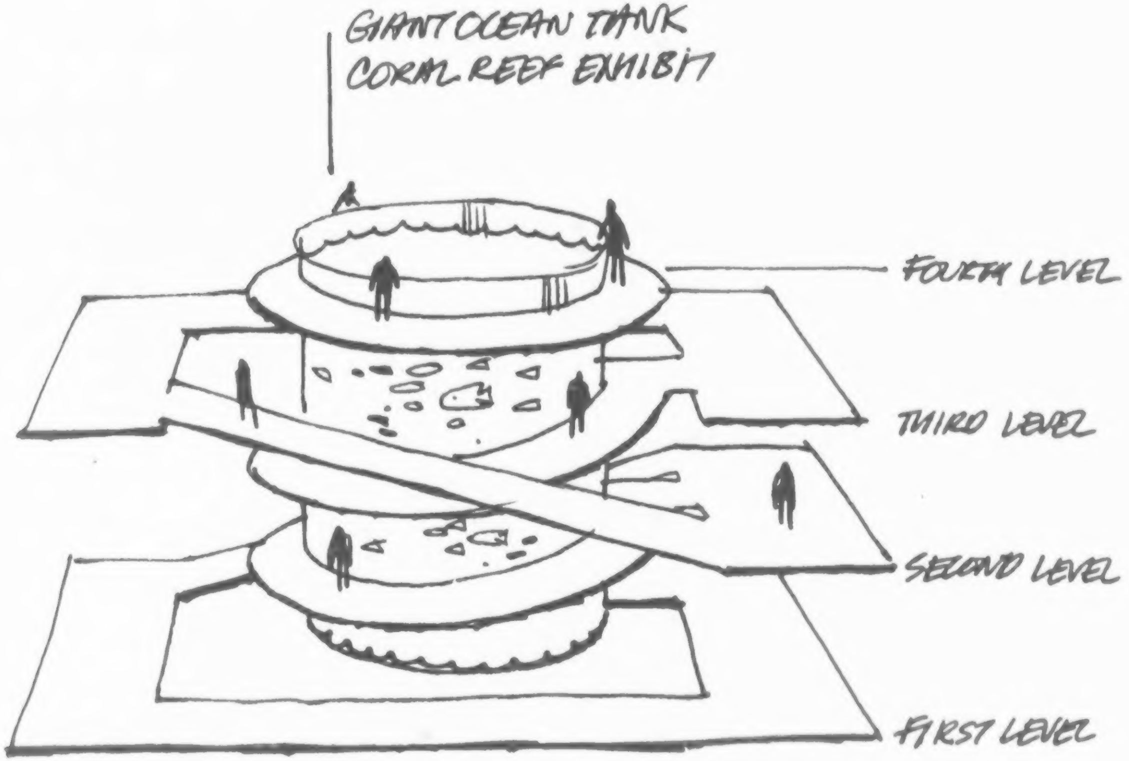
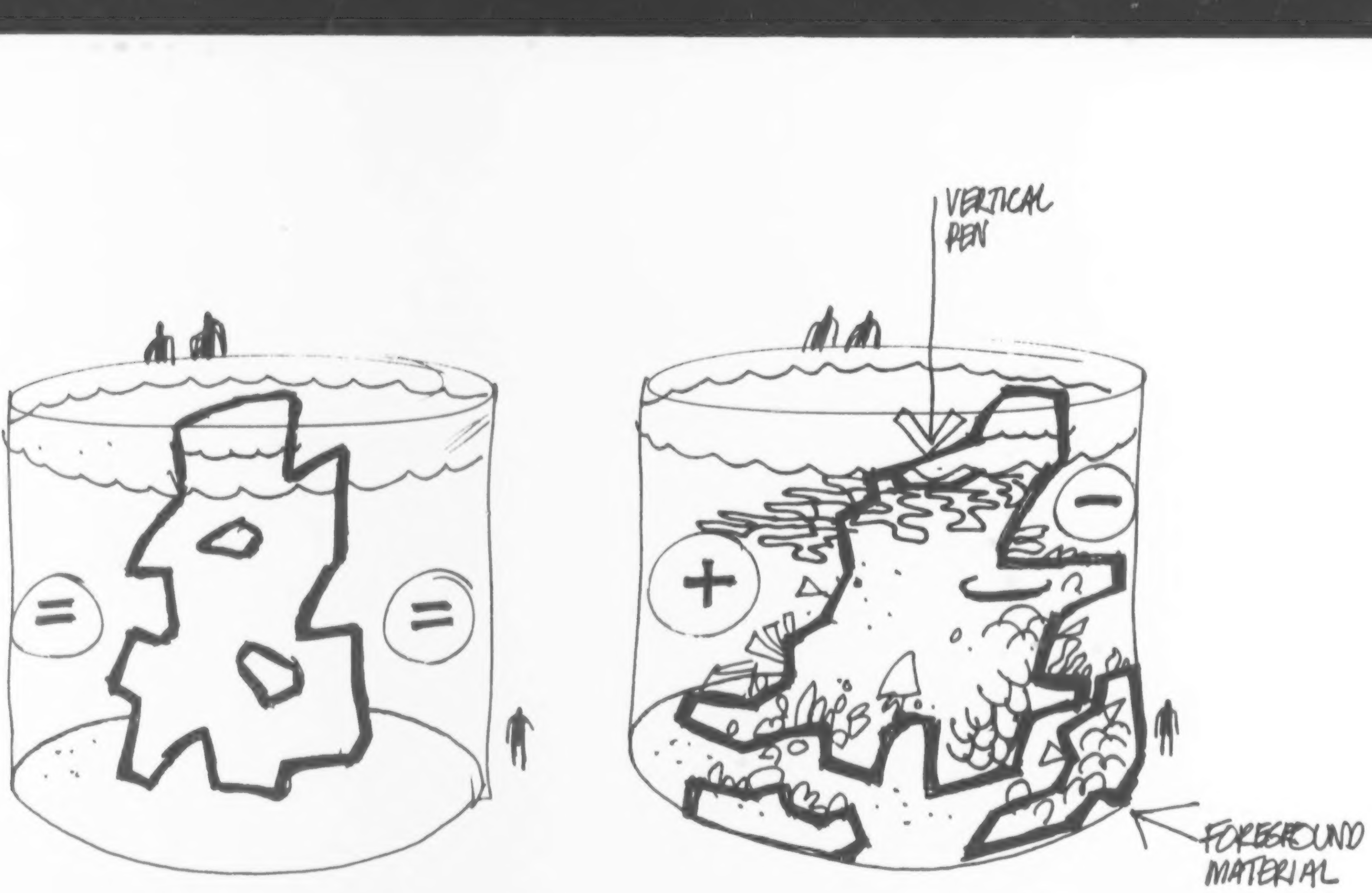

GIANT OCEAN TANK
CORAL REEF EXHIBIT
FOURTH LEVEL
THIRD LEVEL
SECOND LEVEL
FIRST LEVEL

FIGURE 1.


=
=
VERTICAL PEN
+
−
FOREGROUND MATERIAL

ORIGINAL REEF EXHIBIT

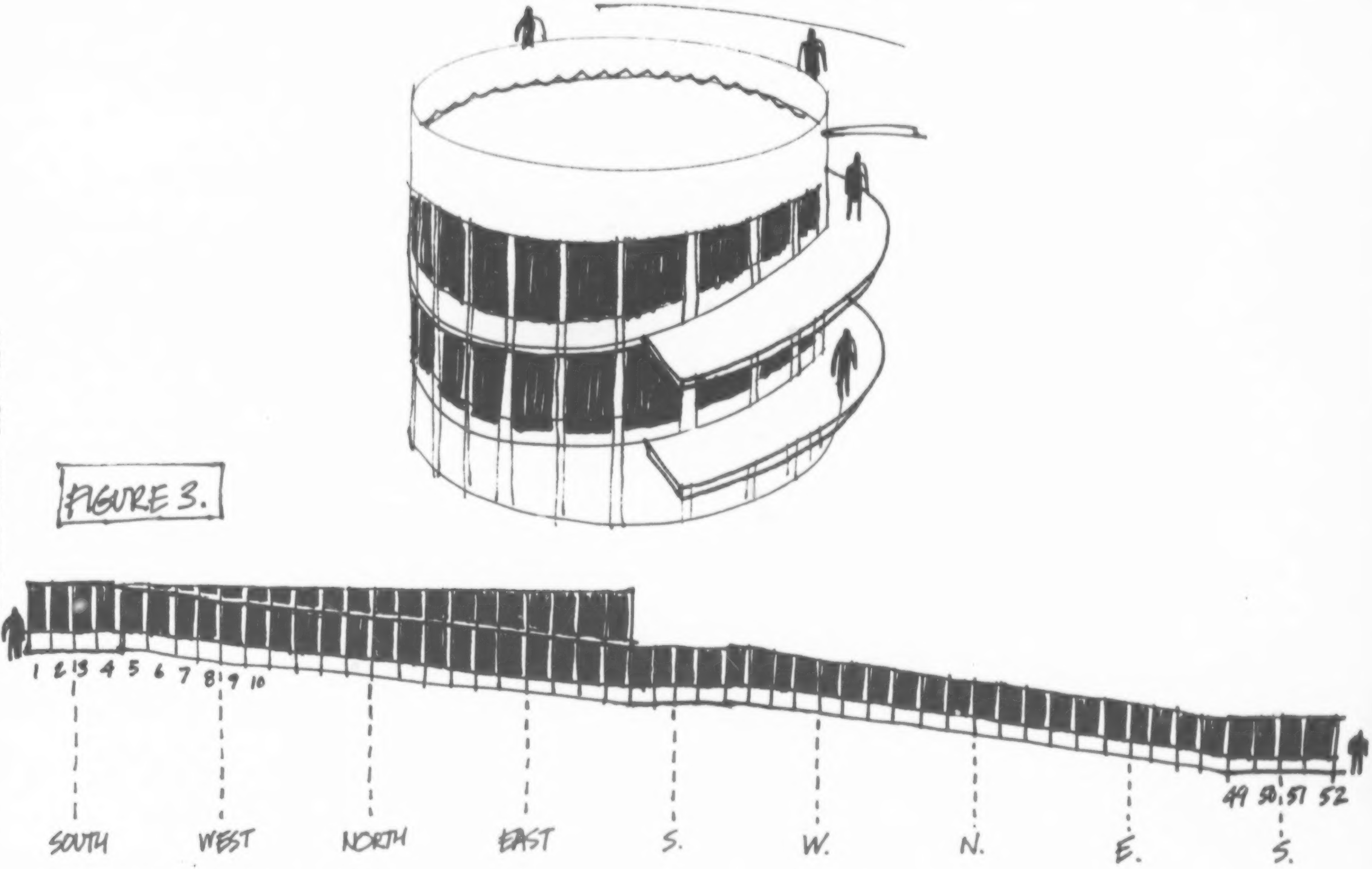
NEW CORAL REEF EXHIBIT

FIGURE 2.

NEW ENGLAND AQUARIUM CORAL REEF EXHIBIT

RL. 6.12.85

FIGURE 3.


1
2
3
4
5
6
7
8
9
10
49
50
51
52
SOUTH
WEST
NORTH
EAST
S.
W.
N.
E.
S.

NEW ENGLAND AQUARIUM
CORAL REEF EXHIBIT

FILM-LIKE SEQUENCE OF WINDOW FRAMES

RL. 6.12.85

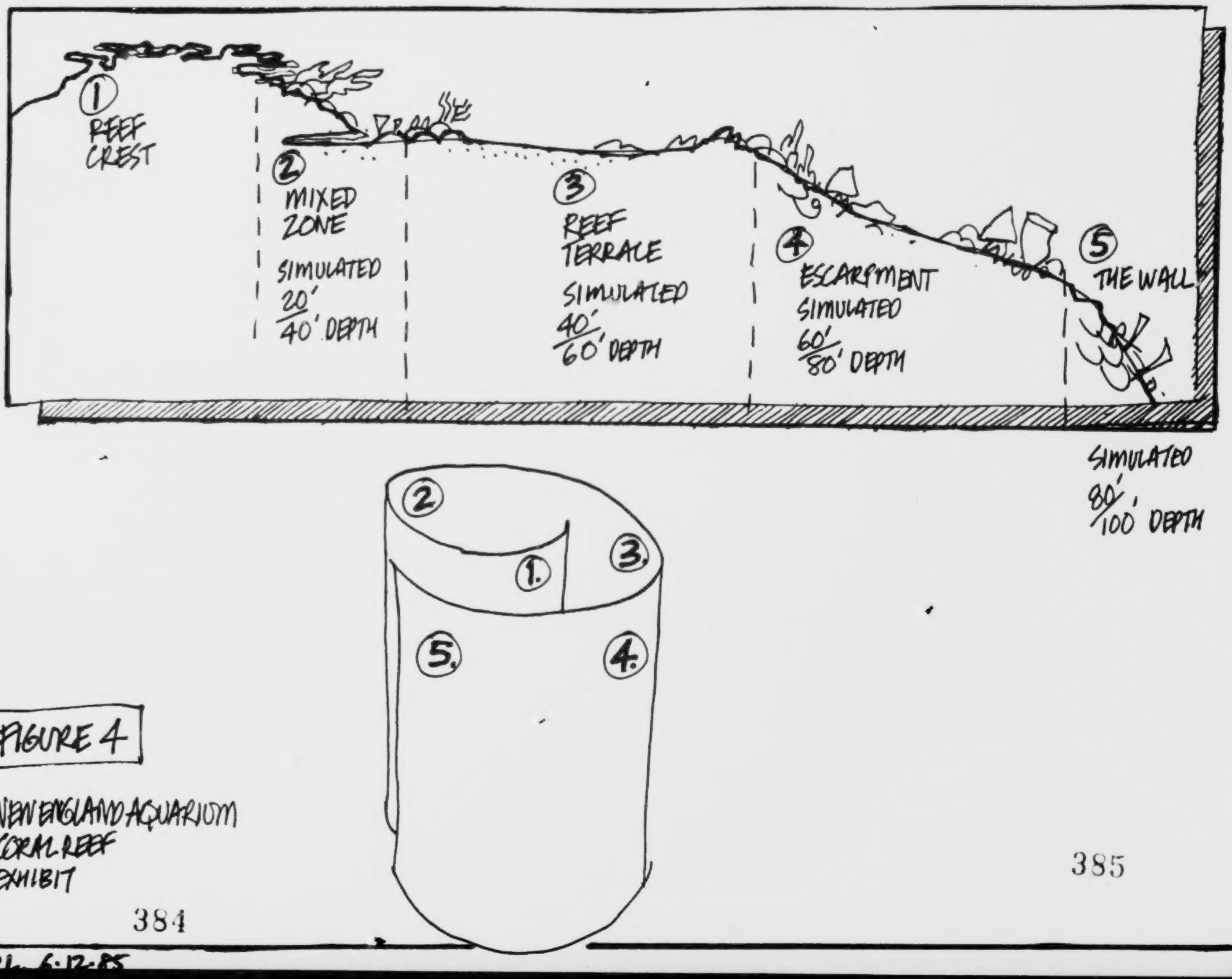

① REEF CREST
② MIXED ZONE SIMULATED 20'/40' DEPTH
③ REEF TERRACE SIMULATED 40'/60' DEPTH
④ ESCARPMENT SIMULATED 60'/80' DEPTH
⑤ THE WALL
SIMULATED 80'/100' DEPTH
2
1.
3.
5.
4.

FIGURE 4

NEW ENGLAND AQUARIUM
CORAL REEF
EXHIBIT

RL 6-12-85

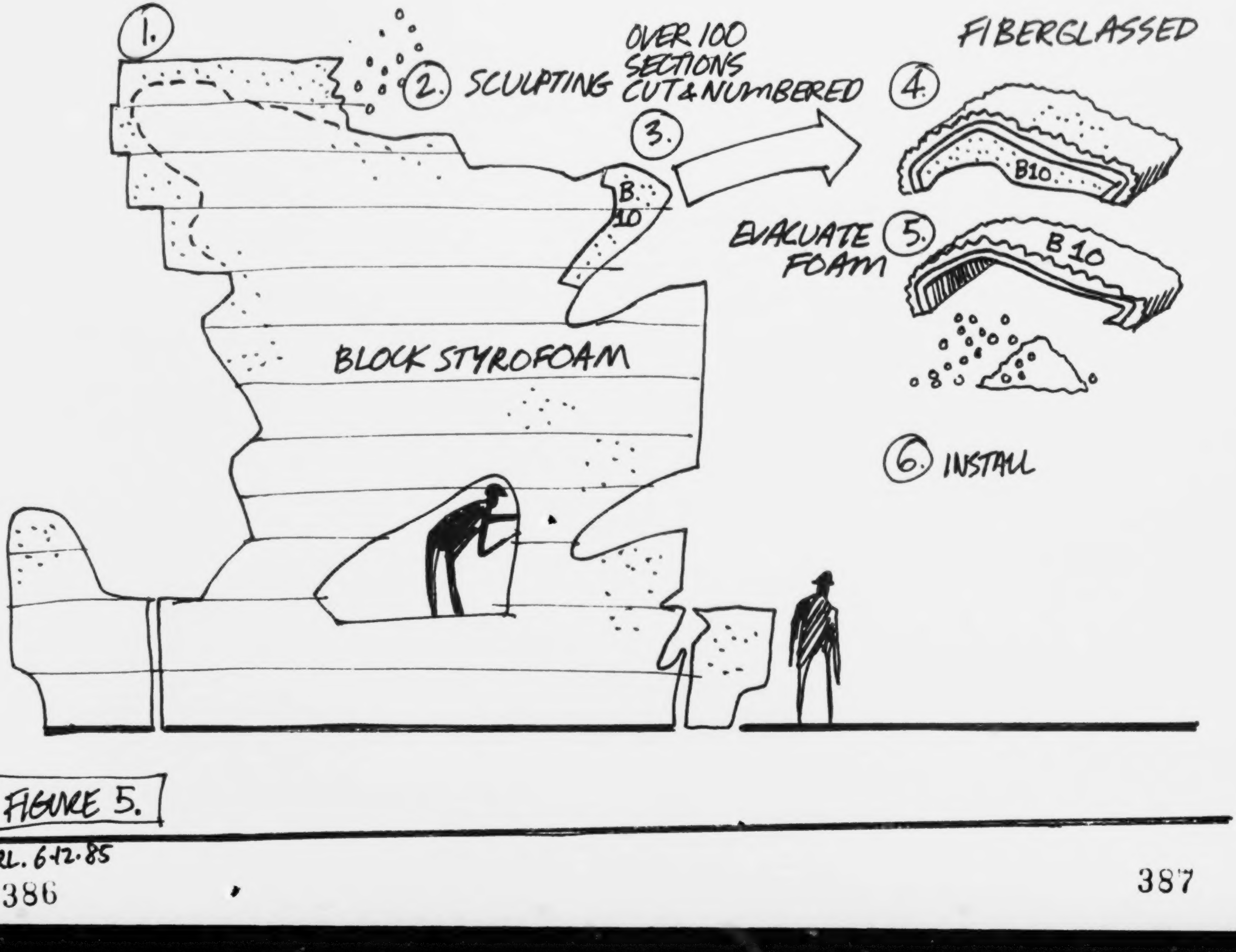
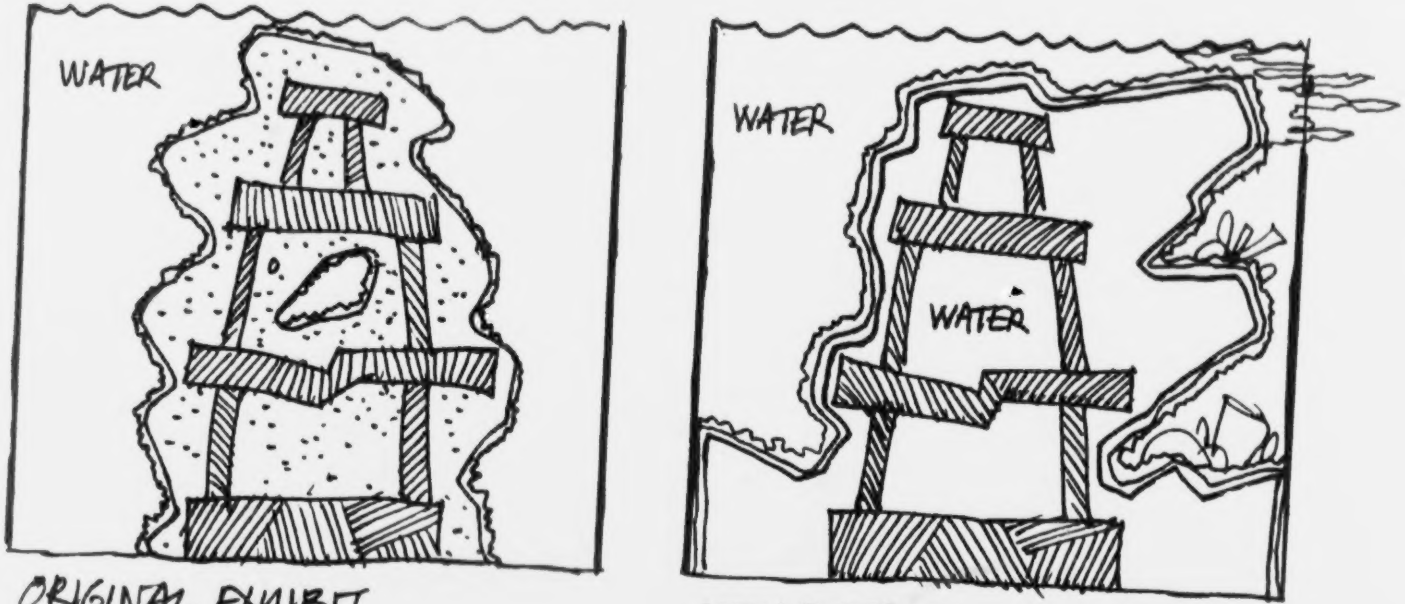

1.
2. SCULPTING
OVER 100 SECTIONS CUT & NUMBERED
3.
B. 10
FIBERGLASSED
4.
B10
EVACUATE FOAM
5.
B 10
BLOCK STYROFOAM
6. INSTALL

FIGURE 5.

RL. 6-12-85


WATER
WATER
WATER

ORIGINAL EXHIBIT

NEW REEF EXHIBIT

FIGURE 6.

RL. 6.12.85

A NEW PUGET SOUND PROJECT

Y. Sherry Sheng, Director
The Seattle Aquarium

Recent discoveries of diseased fish, pollution hot-spots and other signals of potential threats to the health of Puget Sound have served to create a high level of public interest and concern.

Because of the many jurisdictions that share responsibility for the state of the Sound, and the complexities of management issues, public information and education have lacked focus and have been difficult to coordinate.

The Seattle Aquarium was selected to coordinate the State of The Sound project because of its central location, its high visibility and attendance (about 500,000 people visit The Aquarium annually), and its existing charge to interpret the local aquatic environment to the public.

This project, bases at The Seattle Aquarium, is designed primarily to focus public attention and to provide educational and interpretive resources about a serious major environmental concern - the state of Puget Sound. Initially, it will consist of exhibit and public program elements to be completed by June of 1986.

* Puget Sound: "Today and Tomorrow" a permanent public exhibit consisting of a display incorporating live specimens and graphic components which speaks to the environmental health of Puget Sound. This exhibit also informs the public about individual action to help alleviate pollution.

* Puget Sound Monitoring Station: A "hands-on" sampling station where visitors will be able to test water quality, record animal populations, monitor water movement and observe such techniques as plankton collection and the capture of live specimens.

* "Adopt-a-beach" Program: A public information campaign through which local citizens will help generate physical and biological data about public beaches and will be encouraged to become forces for a clean Puget Sound.

* Educational Programs: Besides lecture series, workshops and field trips, Aquarium education staff will produce curriculum packets on Puget Sound for use by teachers in public and private schools. Teacher in-service training will also be conducted.

The Seattle Aquarium plays a lead role in the planning and implementing of the project. Funding for the first three elements of the project have been provided by the Washington State Department of Ecology, the Federal Environmental Protection Agency, the Corps of Engineers, the City of Seattle, and other public agencies. The cost of the initial components will be about $160,000.

The Aquarium is seeking additional funds for the remaining components, targeted for completion during the next two years. These components are:

Permanent Exhibits

- "Puget Sound: The Entity": An introduction to Puget Sound's glacial origin, its boundaries, physical characteristics, water circulation, nutrient inputs, etc.
- Puget Sound Discovery Room: A resource room where leisure learning happens through the use of computer, videotapes, preserved and live specimens, models, artifacts, and puppets.
- Puget Sound Tidepool: An engaging exhibit where tidepool animals live in a wave-crashed environment. The exhibit will include a touching pool to allow interactive experiences.

Educational Program:

- Puget Sound on Wheels: A children's outreach program to be conducted by a marine science specialist who will take information about Puget Sound animals to children at community centers and playgrounds.

Habitat Enrichment for Coral Reef Fishes

Paul L. Sieswerda
Curator of Fishes & Mammals
New England Aquarium

Naturalistic displays have been progressing within zoos for a number of years. Not only are natural displays more aesthetic to the visitor, but there is good evidence that animal behavior is enhanced and captive stresses reduced. The further one departs from the old concrete and tile cells common in zoos of previous decades. There is still much to understand about animal needs that should be provided in captivity. The public perception often anthropomorphizes and thinks curtains on the windows are essentials for "happy" animals in captivity. Those of us in the business know that while habitats can be directed toward the natural scene, compromise will always be a part of captivity. Our job is to be sure that the pluses of captivity outweigh the minuses.

Public education and awareness are probably the most compelling justification for animal displays. There is also the progression of understanding that has developed in zoos and aquariums about animal behavior and physiology as well as environmental needs and how they can be attained in a captive environment. Zoos and aquariums have come a long way, but there is still a long way to go. Some zoos have progressed in the other direction as well. They are setting aside large areas of land that can allow more natural conditions, naturally. That is one look to the future, enhanced management of captive displays is another.

Recently, aquariums have available the ability to fabricate artificial materials which can duplicate the formations of many natural substances. Corals and reef structures are nicely copied in fiberglass by molds or sculptures. These formations can greatly aid not only the aesthetics of the display and the educational presentation of a "total environment" but also the behavior and environmental needs of the animals. It is a further step in enhancing the presentation of aquarium displays to the benefit of the public appreciation and the enrichment of the animal's captive habitat.

The renovation of the Giant Ocean Tank at the New England Aquarium has attempted to present a naturalistic reef that depicts various zones common to a Caribbean Reef and the animals which would naturally occur in these areas. The reef's population, is by necessity, compressed as is the space to depict a cross section of a reef that might be hundreds of yards wide to a depth of 80'; in the constraints of a tank 23' deep and 40' in diameter.

The evaluation of the success of this display will be an ongoing process as we learn which animals do well and which do not in the habitat. The structures and coral arrangements also may be changed or "grow" as we find that certain provisions for some fishes are needed. The premise for both the problems and the success for this display is that a naturalistic exhibit will present a natural reef scene, inhabited by both large and small fish and subject to some of the laws that prevail in the wild. The natural behaviors of the animals, some aggressive, some mutualistic, can be observed and better understood in such an environment.

One such natural behavior is that big fish eat little fish. This fact of life can be balanced by two measures which we can control when we exhibit our collection. 1.) We can reduce the predatory drive in the larger animals by providing food without hunting; 2.) We can provide safe havens for the smaller fishes by constructing corals of intricate shape and form to give hiding places.

Dick Lyons has presented the constructon process which provided these structures. I would like to share some of the results of this premise and evaluate where our efforts worked and where we might seek improvements. The process is dynamic and it will be only after a longer view can be seen that we can evaluate with any real clarity the population success of the exhibit. Comparisons of densities versus the wild would be extremely interesting. At this time (1 year +). The analysis is also clouded by the effect and treatment of a troublesome parasitic Benedenia melleni. It may be of interest to relate the events of our treatment, but it cunfusing to the analysis of losses due to predation.

The monogenetic trematode, Benedenia has been a recurrent problem in the Giant Ocean tank since its early operation. Repeated treatments with trichlorform (.25 ppm/hr/4hr) had kept the disease in check, but never eradicated the parasite completely. During the renovation project we tried to start afresh since the entire system was emptied and all of the fish were moved to holding. During the transfer of the fish back to the Giant Ocean Tank, a fresh water dip was administered to all the animals in the hope that this process would clean up the parasite once and for all. All new fish would be quarantined and treated before introduction to the new system. This plan did not work. Either because of the execution of the dips or life stages protected from the treatment, perhaps eggs, the parasite reinstated itself within the collection. In fact, the situation was worse because of the increase in population of fish particularly susceptible to the parasite. The previous collection housed mainly large bony fish and sharks which were not prime targets for the parasite.

We are pleased with a recent copper treatment in which we sustained a level of .15 to .2 ppm over a 20 day treatment period. The outcome will have to be judged over a longer period, but 2 months have passed to date without observation of Benedenia.

The analysis of fish mortality since the renovation is therefore complex, with losses due to: 1.) parasitic infestation; 2.) adverse reaction to treatments; 3.) predation.

Fish losses due to parasitic infestation were animals which were particularly susceptible to the parasite- butterflyfish, spadefish, angelfish, and small permit. The treatments of trichlorform we believe were responsible for the loss of two lemon sharks and various jacks. Copper treatment coincided with the loss of a number of blue tangs and angelfish.

The introduction of naturalistic coral formations has provided similar niches within our reef, totally artifical, as would be found on a natural reef. The correlaton of natural habitat to artifical is quite consistent. It was comforting to see that the fish read the same books we did and cooperated in filling most of the niches we provided for them.

On our reef crest and shallow flat, barracuda hang in identical behavior as on the natural reef. Jewelfish, damsels, wrasse, and small angelfish dart in and out of the fire coral stands. When the fiberglass corals were attached, nooks and cranies were constructed to allow the smaller fish to slip under, as well as between, the pieces.

The cruising jack, permit, and snappers may account for the missing bluehead wrasse which we hoped would swarm above the coral heads. This fish's behavior seemed the most susceptible to predation. The predation is assumed because we did not observe actual attacks, but only missing fish. The MIA's were primarily blue chromis and bluehead wrasse whose behavior as planktivores take them slightly above the reef's protection and at risk to the larger fish as they cruise the open water. Natural behavior for both species!

Other wrasse which hide in coral formations have done well. In fact, the fish which inhabit the actual reef structure seem quite safe from predation, no matter how small. The royal grammas are particularly realistic in their behavior on the underside of dark overhangs. The fish orient themselves upside down in reference to the overhangning substrate and dart in and out of the holes provided for them in the fiberglass.

The approach toward a mixed species, naturalistic display brings many advantages of presentation educationally and visually. However, it is not without problems for the husbandry of the exhibit. Essential to the process is an understanding of the animal in the wild and how its needs in captivity can be accomplished. Knowing what the fish want to do will shape what we want them to do. The more "natural" accomplishment in habitat can at times develop into a concern behaviorally. For instance, as the habitat becomes more natural, natural behavior of territorial aggression can develop. Blue and queen angel fish develop territories and competitions which do not bother the grays or french angels which simply wander about the reef. How much territory does a queen angel need? A natural setting in artificial fiberglass may lead to an answer to these questions in the aquarium. The Giant Ocean Tank is no longer a merry-go-round of circling fish. It is now a habitat where many of the life processes can be observed from spawning behavior to territoriality. It is a continuing challange to learn from and enhance these processes in captivity.

There are two construction aspects which may be of interest to report as part of the renovation of this exhibit.

1. Circulation: The circulation to the system was divided into interior and water column flow patterns. A quarter of the flow was directed internal to the hollow structure of the reef so that a positive pressure within the reef directed water flow to all parts of the formation and out small holes through the reef walls back to the water column. In this manner a simple and fail safe process prevents dead water space and anerobic build up. The remainder of the circulation flow is directed 45 degrees from the bottom to the top from four quardrants so that a slight clockwise current is established in the tank.

2. Ozone: Installation of a ozone generating machine has greatly helped the clarity of the new reef. Some reduction of algae growth has taken place as well.

A 5 lb/day generator injects a portion of its capacity (about 1/2 lb/day) into an aeration chamber prior to water returning to the tank from the filters. The injection takes place into a 12" PVC pipe with a flow rate of 2500 GPM and is dispersed through numerous 2" laterals. The water is aerated with no residual ozone measurable as it leaves the pipe. Disinfection does not take place since the necessary 2.5 mg/l is not attained due to the short retention time. Our concentration is approximately .08 mg/l which is very effective in removing dissolved organics and giving the water an attractive sparkle.

WAVE CRASH AND INTERTIDAL EXHIBITS AT THE MONTEREY BAY AQUARIUM

A look at the techniques used in duplicating a section of surf-swept rocky coastline of Monterey Bay

by Charles Farwell
Curator, Monterey Bay Aquarium

Displaying intertidal plants and animals is a difficult exhibit challenge. The intertidal zone can be physically harsh and adaptation to environmental conditions has created an assemblage of plants and animals that not only thrive in this environment but actually require these conditions for survival. Environmental conditions common to this community includes exposure during low tides, temperature extremes, changes in salinity during rainy seasons, and pounding surf.

The first displays of the intertidal area in a museum setting were standard aquarium displays showing a collection of plants and animals gathered during low tide. These displays have always been popular, particularly with those living near the coast. Unfortunately, this type of exhibit is limited to hardier species that can be maintained and often requires frequent collections.

The popularity of this type of exhibit eventually led to the creating of an open pool design where visitors could look down on the animals instead of through glass. This eventually led to more elaborate types of displays utilizing materials and design techniques that helped create a naturalistic depiction of the intertidal-wave-swept environment. Artificially constructed rockwork with crevices, channels and overhangs allowed the intertidal fauna to select areas that met their requirements for exposure to the environment and predator avoidance. Water movement, through simulated waves, was also found to be beneficial to both plants and animals and added to the visitors' enjoyment by providing a new dimension to the display.

Through the engineering and design concepts of Monterey Bay Aquarium staff an intertidal exhibit was made that not only incorporates existing technology but includes a crashing wave, changing tides and elaborate rockwork representing local rock outcroppings of the Monterey Peninsula geology. The result of this work is an assemblage of intertidal algae and invertebrates that are naturally distributed according to their biological requirements, i.e., pounding surf, wave-swept rocks, quiet pools and exposure during low tide. The technical details involved in setting up and maintaining this exhibit are as follows.

This exhibit consists of two entities: the wave crash exhibit and the tidepool exhibit. The wave crash display is behind a glass viewing panel and is located inside the building. The tidepools are located out of doors on the deck. These two exhibits are connected by a rocky channel. Seawater travels from the wave crash zone through this channel and out into the outer pools. The intertidal exhibit is arranged as a representative cross-section of an intertidal area. The pattern of water flow is from the wave crash display to the lower subtidal pool, then to the mid-intertidal zone pool. At high tide water will overflow to the high intertidal zone pool. The water volume of this display is approximately 2,000 gallons; water is circulated from the middle pool through a subsand filter of about 25 square feet. A fiberglass pump coupled to a 3 hp motor takes water from this pool at a 250 GPM flow rate. The water is temporarily stored on the second floor in the wave crash reservoir which automatically releases the water from a height of twelve feet. The discharge of water creating the crashing wave occurs every 47 seconds, and it takes one second for the reservoir to empty. The wave volume is 200 gallons. The control valve that releases the water is operated by an air-driven piston in a closed cylinder. The cylinder has a two-way action, being both opened and closed by compressed air. Optical fluid level sensors monitor the volume of the reservoir, as the top sensor is covered with water it triggers a solenoid valve which supplies compressed air to the water release valve opening it. When the reservoir is emptied, a second sensor closes the valve allowing the reservoir to fill. The reservoir is fitted with an overflow drain and a third optical fluid level sensor which will turn the pump off in case of a failure in the wave crash mechanism. This safeguard was provided to avoid the danger of pumping the water out of the exhibit. The wave crash pump is turned off in the evenings to conserve energy. To maintain water quality, seawater is continuously added to the exhibit through the wave crash reservoir. This supply of seawater is added as a breaking wave at ten minute intervals during the time when the pump is turned off and also provides water movement to the algae and filter feeders.

To demonstrate intertidal zonation, the vertical distribution of both plants and animals according to their abilities to withstand exposure during lower tides, a system was devised by our exhibit engineering staff that would continuously change the water height in the middle and upper pools. This system consists of two Hartford loops that are movable in a vertical direction. The movement is controlled by a screw gear run by a reversible D.C. motor. The two Hartford loops are tied together and attached to a screw gear, top and bottom limit switches control the motor's direction of rotation. The Hartford Loops are constructed of flexible tubing and PVC pipe and they move up and down with the screw gear.

The height of the Hartford loops are constantly changing. Since these loops are the overflow for the middle and upper pools, as the loops are lowered, the water level in the display is also lowered an equal amount. The two Hartford Loops are positioned on the screw gear in a manner causing the upper pool to be drained first.

These pools are refilled by make-up water that is continuously added to the exhibit. The speed of refilling is controlled by the movable Hartford Loops. The sequence of refilling is reversed from the drain cycle, with the middle pool refilling from overflow water leaving the wave crash and outer deep pool. Then the upper pool is filled from the overflow water leaving the middle pool.

The speed of the Hartford loops is controlled by the motor speed. The motor speed is adjustable from 15 minutes to eight hours and is currently set for a 3 hour cycle. The vertical travel distance is 14 inches which is the effective tidal range.

The species distribution of algae in the exhibit approximates the natural habitat, thus there are distinct bands of algae in the high and mid intertidal and subtidal sections of the exhibit. Though distinct, these bands are compressed vertically due to the reduced tidal range and exposure time in the exhibit.

Species lists for algae are given in Tables 1 and 2. It is important to note that there is some overlap of a few species between tidal zones. The high intertidal zone is a narrow band approximately two inches high at the high water mark. The midintertidal zone is that area exposed by the movable Hartford Loop and is approximately 14 inches in height. The subtidal zone is the area directly below the lowest tide mark and not exposed. The algae growing in the wave crash channels are listed separately. Many of these algae are only found in open or exposed coastlines subject to surf conditions.

Results . . . a nearly self-sustaining population displayed in a natural setting. Collections are very infrequent. This is due to natural recruitment and setting out of both sporophytes and larval stages of algae and invertebrates. Unfiltered seawater is used adding nutrients as well as introducing sporophytes and larval forms. The existing display specimens have augmented the species assemblage through their own efforts of reproduction.

Subtidal:

Green algae

Bryopsis corticulans *
Codium fragile
Ulva sp.

Brown algae

Cystoseira osmundacea
Egregia menziesii
Macrocystis pyrifera *

Red algae

Calliarthron sp.
Coralline crust(s)
Gigartina ?-*exasperata*/*corymbifera*
Gigartina spinosa
Iridaea cordata
Prionitis lanceolata
Sarcodiotheca guadichaudii (formerly *Neoagardhiella baileyi*)

Wave Crash:

Green algae

Cladophora columbiana

Brown algae

Alaria marginata
Egregia menziesii
Laminaria sinclarii
Postelsia palmaeformis **

Red algae

Botryocladia pseudodichotoma *
Calliarthron sp.
Callophyllis flabellulata *
Corallina vancouveriensis
Coralline crust(s)
Laurencia spectabilis var. *spectabilis*
Microcladia borealis *

* Species not knowingly or deliberately transplated.

** Attempts to transplant adult plants have been unsuccessful. We've had gametophyte settlement and volunteer sporophyte development, however they have not grown beyond about 1½ inches tall. At present only one remains.

TABLE 1

High Intertidal:

Green algae

Cladophora columbiana
Enteromorpha linza *
Ulva sp.

Brown algae

Colpomenia peregrina *
Hesperophycus harveyanus
Pelvetia fastigiata
Scytosiphon lomentaria *

Red algae

Gigartina leptorhynchos
Porphyra sp.
Rhodoglossum affine

Mid-Intertidal:

Green algae

Codium fragile
Spongomorpha coalita

Brown algae

Egregia menziesii
Giffordia ?-*mitchelliae* *

Red algae

Gelidium coulteri
Gigartina canaliculata
Iridaea flaccida
Rhodoglossum affine

TABLE 2

ACKNOWLEDGEMENTS

Many people were involved in putting this exhibit together and should be mentioned for their creative efforts and hard work.

Dave Powell, Director of Husbandry, worked on the conceptual plans and all of the details through its completion. Derek Baylis, Exhibit Engineer, designed and fabricated both the wave crash and tide mechanisms.

The following aquarists are to be acknowledged for their efforts: John Christiansen, who solved several water system problems; Mark Ferguson and Freya Sommer spent many early morning hours collecting specimens; Roger Phillips collected and glued many species of algae onto the rockwork and supplied the data listed in these tables; and finally, the exhibit design team that drew the plans for both the exhibit and rockwork.

SHARKS: Recent Advances in Captive Biology

A review of the shark research program at the National Aquarium in Baltimore and the recent symposium on the captive maintenance of elasmobranchs*

By:

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Since its before its opening just over four years ago, the National Aquarium in Baltimore has had a commitment to establishing a continuing research program at our facility. As with any of your own institutions, the Aquarium realised that it could not be all things to all researchers, and some limitations would have to be placed on the program. It was therefore decided very early on that we would concentrate on specific research problems encountered in the aquarium world, with the research being done by either our own staff or through outside researchers.

Quite understandably this program immediately became immersed in the problems of maintaining sharks in captivity. As many of you are already aware, there are many unanswered questions that one could research in this fascinating field, and a further decision to limit ourselves was then needed. Fortunately, or unfortunately as the case may be, fate smirked at us and we immediately launched ourselves into the problems we encountered in capturing and transporting sharks when it came time to collect the first specimens for the Aquarium.

The collection of sharks can be a tremendously frustrating and stressful time for aquarist and shark alike. Many of the techniques used to capture sharks involve either nets or hooks and can physically harm the animal if precautions were not taken. Preliminary blood work on sharks just caught in the field indicated that severe physiological alterations were taking place in these animals which could be predisposing specimens towards disease and eventual death. We have observed that serum electrolytes and enzymes change during transport. While mostly centering around sodium and calcium, other ions are found to change as well as the increasing of liver and muscle enzymes in the blood. The traditional shark ringers solution in use was found to vary significantly from that of wild sharks and those acclimated to captivity.

Through the work of Dr. Ray Jones at the University of Maryland School of Medicine, we found we could best apparoximate the baseline electrolyte values in sharks by using a modified Hanks Balanced salt solution supplimented with urea and eliminating the addition of the phenol red indicator. This solution is a standard cell culture medium used to maintain shark cells in culture. As a second part to the solution to this problem, a suspension system for the transported shark was developed in order to reduce traumtic contact with the transport container, more closely approximate the swimming posture of the animal, and help maintain a more normal muscle tonus during transport. The basis for this device was freely appropriated from a very similar device developed by John Hewitt of the Steinhart Aquarium and John Rupp of the Point Defiance Zoo and Aquarium.

In mock transport trials, the replacement medium administered in a slow intraperitoneal drip was found to adequately maintain electrolyte balance. These trials were also used to adjust the transport device so as to eliminate several postural difficulties. It was hoped that this year extensive field testing could be initiated using both the replacement medium and the transport device. Unfortunately, we did not obtain number of large sharks necessary to adequately test this procedure, and field testing has been postponed until next year.

Among some of the problems readily apparent during any transport or similar handling was that of anathesia. It was felt that the immobilization of larger sharks in captive situations could be greatly facilitated by the use of effective drugs administered intramuscularly. By using a pole syringe, delivery to large specimens without prior restraint is possible as is the ability to reduce water contamination. To date, the drugs that have been used in developing this procedure are a combination of Ketamine and Xylazine. The combined injection of these drugs reduces reactivity and significantly aids in the stretchering and manipulation of the shark for other procedures. Other drugs used in anathesia are also under review by our staff for possible application.

Once one has the shark safely immoblized it then becomes possible to perform a large number of sensitive tests and diagnostic procedures. Among those that have been attempted at both the National Aquarium and the New York Aquarium is the visually guided biopsy and laproscopy, the direct visualization of the animals internal organs.

In a similar vein, it is now possible to perform safe biopsy techniques for one of the problems most frequently encountered in captive sharks, that of "goiter". Thyroid

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enlargements in captive sharks are little understood and therapeutic and preventative measures now is use may have little or no basis in the pathogenesis of the condition. Through the use of this technique it is now possible, in conjunction with serological determinations of thyroid hormones, to routinely histologically assess the biopsied tissue to allow for the precise monitoring of thyroid condition and response to therapeutic manipulations. While the preliminary results are not immediately conclusive, the development of this technique will allow us to monitor the ongoing condition of our captive specimens and compare such to the wild animals under study. Furthermore, it is now allowing us to engage in some controlled experimentation in which we hope to stimulate this condition in captive sharks and then attempt to reverse it through therapeutic or environmental means. The first of these studies is presently underway.

Infectious diseases can be a common and often devastating problem in captive sharks. Any infectious disease may be divided into two basic parts: that of the causative agent; and, that of the indicated effective therapy. Through a program of intensive necropsies performed by the University of Maryland's Department of Pathology, our program has compiled over 3000 slides on both normal and abnormal fish tissues. Many of these involve sharks. This collection of slides is presently listed with the Armed Forces Institute of Pathology in Washington, D.C. While identifying many pathogens known to produce disease problems in sharks, we have also found at least one new species of bacteria felt to be specifically pathogenic to sharks. Christened Vibrio carcharinidae, the bacteria was found by Dr. Jay Grimes of the University of Maryland during the routine identification of cultures from a shark necropsy.

The introduction of therapeutic agents to diseased sharks has largely been done through empirical methods. In other words, "we shot it full of this at level x and it lived, ergo it was cured!". It has only been within the past few years that investigators and aquarists alike desired to know more about exactly what was happening whenever an animal was under antibiotic therapy. Several studies have been done and are presently continuing to docuement the various levels at which therapeutic agents are being given and should be given to sharks. Among those under study at our facility are chloroamphenicol, tetracycline, gentamycin, ampicillin, and tobramycin. To date, we have also done studies on the dosage levels needed to reach effective serum levels of both gentamycin and tobramycin.

Now I don't mean to imply that the National Aquarium is the only institution that is engaged in research on the captive biology of sharks. Virtually every institution that has maintained these fascinating animals has made a worthwhile contribution to this field of study. However, much of what has been done has not been published as yet (who among us believes that we have the time to churn out several papers each year on our work!), or is just not readlily available for a variety of reasons. Realizing this, and working from the many "wouldn't it be nice" statements about sharks in captivity, the National Aquarium undertook an assessment to see if it would be worthwhile to sponsor a conference on the captive biology of sharks. The response was, to put it mildly, quite phenomenal.

Organized in just over eight months, the conference took place in April of this year. It brought together approximately 105 researchers, curators, aquarists, and students in what we feel was a tremendously successful meeting. The topics were chosen by the organizing committee so that every aspect of sharks in captivity would be covered, and ranged from a review of the helminth parasites of sharks to the capture techniques and husbandry practices for maintaining the whale shark. Virtually every aquarium in North America was in attendance along with most of the aquatic-oriented research laboratories.

Among the presentations were a series of video presentations ranging from the recording of egg laying behavior in several species of sharks to that of using operant conditioning to train nurse sharks. Demonstrations of post-mortem examination and other clinical techniques were also shown. In addition, a special poster session was held for those who wished to present an unsolicited paper.

The proceedings from this conference are now in the planning stages for publication and it is hoped that they will be available within the next year. The only item that was left undone at this conference was setting the date for the Second Conference on the Captive Biology of Sharks. Based on inquiries stemming from the first conference, it is anticipated that close to 250 individuals could attend that meeting. The interest and spirit that made the first meeting a success remains. All that is needed now is for some institution to host the next one.

THE CARE AND FEEDING OF ZOO EDUCATORS

Judith A. Breuggeman, Ph.D.
Michael Borsack
Susan Matthews
Busch Gardens Zoo
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A little over six years ago, I entered the zoo profession with the title of Zoological Education Coordinator . . . whatever that was. In 1980, I eagerly attended my first regional and national AAZPA conferences. I knew what I was doing more or less, but I was anxious to learn what the rest of the Zoo Education world was doing.

At that time the image my inquisitive mind was receiving about zoo educators was much less than a perfect one. I was not sure how the image was being derived. I really was not meeting too many inflexible "busy body" schoolmarms with little or no knowledge of conservation, animal biology and husbandry, or animal adaptations and behavior on the one hand, and no interest in anything but school children on the other. But that did seem to be the image my fevered brain was receiving. I shrugged my shoulders and decided to "keep on keeping on". I was meeting and networking with an increasing number of bright, creative, hard working souls that called themselves zoo educators. They did not strike me as acting like schoolmarms. They did not appear to be the proverbial difficult and inflexible people. I concluded that maybe there were some with whom I just had not had much contact.

Our Phoenix conference marked the beginning of my involvement with the Public Education Committee. This meant I had increasing contact with zoo educators from everywhere.

Sometime during this past year, I dug in my heels, lowered my head and issued my threat-bark over the phone to Brandy Pound sitting in San Francisco on the other end of the phone line: "It's wrong", and Brandy in her usual soothing voice replied: "Of course".

I began calling zoo educators and zoo directors around the country. We talked about the bad old days and we talked about much of the excitement in zoo education that characterizes our lives today. The AAZPA Board of Directors is being increasingly concerned about and supportive of efforts in zoo education. Across the country we hear of multi-million dollar educational complexes. We hear of more educationally oriented childrens' zoos. We hear of interactive zoo labs, herp labs and more. Zoo Education today is certainly alive. But is it well and happy?

I made up a questionnaire that tried to address the stereotypes of the bad old days. My mailing list consisted of the 168 institutions listed in the AAZPA Directory as having educational programming. I gleaned another 50 likely addresses from the ZIP mailing list. I am told I had a few duplications and I certainly did not allow much time for response. I received an astounding 110 responses, many of which were filled with detailed comments. No one can say that zoo educators do not answer their mail. And they are quick too.

The good news is that there is indeed a pot of gold at the end of the rainbow. The bad news is that there may be a few thorns among the roses. Either way, it is great news to those of us who have known for years that it is a bright and exciting world for zoo education.

Who responded? Zoos that are not listed in the AAZPA directory accounted for 14% of our respondents. Another 21% of the respondents represent institutions housing fewer than 500 specimens in their collection, while 25% represent institutions with fewer than 1000 specimens. Further, 24% have fewer than 3000 specimens, and 16% have more than 3000 specimens. What a sample!

Zoos account for 79% of the respondents, with 9% being from aquariums and 12% of the institutions consider themselves to be both.

Most of the respondents (52%) were from small management teams of less than five people and 78% report directly to the director of their institution. Unfortunately, we also receive word that almost 13% of our sample population have no paid personnel contributing to their educational efforts.

Are we professionally trained? Yes, in fact 15% have Ph.D.'s on their education staff and only 9% have no college degrees on staff. An astounding 21% of our responding institutions have five or more people contributing to education with at least a Bachelors Degree in hand. But is it science? Yes, in fact 69% of all the degreed staff have been trained in scientifically oriented degree programs, and more than two-thirds of the science-types came to us from zoology progams.

As for other training, for whatever reasons, 83% of our respondents have not attended the AAZPA management school program, even though only 31% report that none of the rest of their management team has attended either. This is a discrepancy that we should perhaps consider.

Is zoo education important back home? Almost 7% of our respondents said they should be more important than other departments in their institution. And surprise, but 4% said in terms of available time, money and resources, they were more important. There was less correspondence between the 90% who felt they should be equally important and the 46% who said they were equal in terms of available resources. Examples of equality fared better with 58% having equal representation at national and international meetings, and 65% reporting comparable or even better beginning salary levels.

How are zoo educators utilized back home? Very well, thank you. With 51% reporting that they were consistently a part of the team with all that their institution endeavored to do and another 30% reporting that they were at least occasionally involved in team efforts, we can say they are well utilized.

Specific examples of involvement were requested by the questionnaire. A wonderful 58% report being integrally involved in exhibit renovation or planning for new exhibits. Only 21% reported having no involvement in this process.

Coordination with marketing efforts was also examined. Only 13% reported no involvement with marketing, but some of these also reported having no marketing department with which to coordinate.

Signage, brochures, newsletters and AV programs are a daily fact of the workday in most of our zoos. Are educators involved? We have a resounding yes, with between 75 to 85% of all respondents being involved in all of the above. As to how involved they are, 82% report their involvement to be from "frequent" to "exclusive". Even the topic of advertising has 39% of our responding educators involved.

Many of these educators still felt they could be better utilized in-house. Some of their suggestions included more involvement with employee training, long-term planning, more graphics, better exhibits, more in-park programming for the general visitor, and more public relations efforts.

In response to an open-ended question concerning community involvement other than programming for school children, the list was almost endless. In response to an equally open-ended question about how community involvement could be greater, the answers were pretty standard: more personnel, or in many cases, better facilities.

Overall, we can conclude that though the world probably isn't perfect, we can put to rest at least 50% of the myth from the bad old days. We now know that regardless of the size or orientation of our institutions, we have a profile of an educator who works closely and effectively with the other curators and the director of their institution. They are most commonly well trained in the sciences and further, not uncommonly have a well trained staff in their education department working with them. Most important, their effort is well regarded, and they are reasonably paid and otherwise rewarded for that effort.

As I said, so much for 50% of the myth. The rest? Every game takes at least two players. Let's consider those who used to wear the black hats in the old myth: the dreaded, authoritarian, oblivious, and indifferent zoo director of the bad old days. Though honestly, I am not sure I ever met one of those either.

Our zoo directors, likewise, get a good report card. Only 10% or less can be described as unaware, non-helpful, non-supportive and unknowledgeable when it comes to the educational programming at their institution. Between 53 and 67% were described as being "very aware" and "very supportive". Best of all, 40% were defined as being "very knowledgeable" about that programming.

Are our zoo directors aware enough to acknowledge the major achievements of their education effort? Only 15% reported that such achievements were in no way acknowledged and 35% tell us that such things receive acknowledgement in the most important way; the budget shows it.

What about freedom to do the job that needs to be done? Only 4% say they do not have that freedom.

This sounds wonderful. Can it really be? I threw in three questions toward the end of the questionnaire to see if there were any dying embers of animosity left out there. I quote:

> "A zoo director recently said 'Educators believe in a cause. This means they frequently find themselves acting as adversaries in relationships and are viewed as being inflexible'. Is this accurate?"

Only 12% seem to find this a reasonable assessment of our world.

Another question was:

> "Everyone thinks they know about education because everyone can say 'I've been to school myself'. Is this an attitude you might sense in your institution?"

Only 17% say it is a common attitude.

Finally, in response to:

> "Do you think there is agreement at your institution that education should now be a higher priority?"

Only 16% responded that there was no such agreement, but best of all, 33% responded that there was complete agreement concerning the increased importance of education.

The bad old days are indeed long gone.

Think Globally, Act Locally

By: Thane Maynard
Assistant Curator/Education

Each year Americans spend over 1.7 billion dollars on chewing gum. Collectively, we pay out over 3 billion to Las Vegas casinos alone, and it is estimated that in 1985 over 12 billion dollars will be paid for state sponsored lottery tickets. None of these things are bad, and certainly they are not illegal. And no one is forced in any way to participate. But they are handy indicators of the kind of disposable income that Americans actually distribute each year.

By contrast, individual contributions to wildlife conservation efforts average a mere 53¢ per person, for a total of $125 million per year. This is certainly not due to a lack of interest in wildlife. Attendance in zoos, aquariums and botanical gardens is at its all time high. And wildlife books, magazines and television documentaries are ever-expanding. But financial support for conservation, while growing, is growing far too slowly to meet the increasing needs of the late 20th century.

So each year we vote with our dollars that wildlife and its preservation is a very low priority, indeed. Yet put to a vote, few would say something like chewing gum is more important to them than saving the endangered African Elephant or the Blue Whale. The problem lies in the public perception of conservation and especially in their perception of each individual's potential role in saving species of plants and animals.

Conservation is not a dirty word. It does not stand in opposition to logging, home building or agriculture. It does, however, suggest that people plan ahead when using the earth's resources. Conservation means using resources wisely, not just using them up.

In order to help change people's attitudes toward conservation efforts, it is essential to publicize the positive efforts, success stories if you will, currently being undertaken all over the planet. Rather than simply drilling into everyone's head that resources are dwindling, the tropical forests are being burned and chopped down (which they are) and that species are, indeed, vanishing as a result, a la Extinction is Forever, instead we need to let people in on the fact that efforts are currently under way to save many species and wild places. No soft soap selling the idea that all the problems are solved, for they are not. But, people will support a winner, and that winner might just be a conservation project, no matter how remote from their own experience, that has been shown to actually work. Such projects are underway, run by dozens of organizations on every continent.

But much more research, manpower and cooperation is needed to put into effect solid conservation biology. It is estimated that 100 billion dollars per year is the ball park figure needed to be spent on these efforts until the end of this century. In order to move toward that, one step would be to inform the public not only of the necessity of preserving life on earth, but that conservation efforts can get the job done.

Showing examples of the best conservation efforts currently underway around the world. These success stories include:

- Captive breeding efforts have taken off in the last decade making it possible to reproduce many species formerly thought impossible. This can burgeon captive populations, but can also play an important role in learning about species breeding capacities in the wild and move us toward captive-release projects, such as the recent successes with Golden Lion Tamarins in Eastern Brazil and the Arabian Oryz in Oman. The "Millenium Ark" techniques used in modern zoos and research centers like the U.S. Fish and Wildlife Services Patuxant Wildlife Center in Maryland are mind-boggling examples of high technology used in a very applied manner.

- Applied research into the minimum critical size of an ecosystem in order for it to be able to support a viable population of given organisms. Such efforts are underway, sponsored by the World Wildlife Fund and the Smithsonian's Institute for Tropical Studies. This information is especially important in the tropical rain forests, which while making up only 6% of the earth's land surface, are home to over half of the 10 million species of plants and animals with which we share the earth.

- Establishment of National Parks and Nature Preserves is vital to preserving rare and endangered species. But such efforts take international cooperation from governments, conservation groups, scientists and require the support of local people. In order to make a preserve a success it takes the passing and enforcement of laws to protect the resource and local people need to be educated so that they understand a park's importance and help support its existence. The tiny country of Costa Rica has the highest percentage of land in National Parks of any nation in the world. And in the country of Rwanda, in central Africa, the rate Mountain Gorilla is being saved through the combination of education and the establishment of preserves.

THINK GLOBALLY, ACT LOCALLY

It is hard to make the connection between our daily behaviors and the myriad of ramifications they result in, but, zoos have the opportunity to reach a broad spectrum of the population with messages of how their actions affect wild plants and animals, and more importantly how they can be involved as individuals in the conservation movement. What better setting to illustrate that purchasing tables or other wooden products made of teak, rosewood or other Southeast Asian tropical forest species will have a direct affect on the habitat of creatures we love such as Sumatran Rhinos or Orangutans. And something as letigious and bureaucratic as the Endangered Species Act can take on concrete meaning when presented face to face with Lowland Gorillas, Snow Leopards, Phillipine Crocodiles or other "defendants" in the cause.

Americans love an underdog. At this point in our history there is none greater than the endangered species of plants and animals and the wild places where they dwell. Most significant is the fact that all humans, whether urban or rural in lifestyle, depend directly on those species for our existence. The wonder-drug, penicillin, was developed from a fungus; the sea food we are fond of and the wood we build our homes of are all a part of the wildlife picture just as much as the exotic species we often think of. Saving these species, we are trying to save ourselves as well.

But the process is slow. Education is like water against the stone, each drop seemingly insignificant, yet eventually wearing down the stone and changing the direction of the river.

Zoos will certainly not turn the world around by themselves, but they can be a move in the right direction, especially in the developed countries of our overstressed earth, encouraging people to put their actions behind their beliefs.

Annette Berkovits
Curator of Education
New York Zoological Park

WILDLIFE INQUIRY through ZOO EDUCATION
Project WIZE: an investment for the future

John Galsworthy, the noted British author, once remarked:"if you do not think about the future, you cannot have one". Today's zoo administrators and curators are working to ensure that wildlife will have a future. But what will become of our efforts after we fade from the picture? Are today's young people thinking of the future? Will they carry on our work?

Long before the WIZE project began in 1981, many zoo educators and science teachers had a sense that this nation's middle school students needed to be shaken free of their apathy toward the study of sciences. By 1980 it was obvious that adolescents across the nation were dropping out of science courses at an alarming rate. With these "dropouts" from science were the future zoologists and curators of America. Educators and parents had an uncomfortable sense of discomfort about young people's lack of concern with the future in general.

Even before an avalanche of studies, government reports and articles had finally exposed the dreadful state of education at the middle and high school level, zoo educators realized the value of their collections in upgrading the quality of life science instruction. Moreover, a realization dawned that more effort must be invested in getting the attention of adolescents- the pimply, rebellious youths, in whose hands the future of wildlife will eventually rest. Despite their apathy and often exasperating behaviors, hidden underneath a facade of rock music and punk haircuts lies the future hope for wildlife survival. Who is to tell which of these young people is the Beebe, the Hornaday, or the Conway of the future?

A pre-project study of 65 zoos conducted by the WIZE team revealed that although an overwhelming majority of zoo educators desired to attract adolescents and their teachers for zoo programs, they experienced difficulty in doing so, because they lacked appropriate program materials. Similarly, the great majority of respondents stated a great desire to address the needs of the middle school student once appropriate materials became available.

Clearly, the awareness of the needs, the expertise, the sense of readiness and the sense of urgency were there, ready to be tapped. Yet, one key ingredient was missing in order for zoos to make their priceless collections attractive to adolescent learners and teachers. That ingredient was money.

Money is like a sixth sense without which you cannot make a complete use of the other five.

Fortunately, the federal government does not always "taketh away". In 1981 the National Science Foundation demonstated its comittment to revitalizing science education when it provided us with that sixth sense - the funds necessary to undertake a massive zoo curriculum development project. The grant award signalled a recognition that the tide of science dropouts could be stemmed only by employing approaches more relevant to the eighties and nineties. In making its award to a consotium of zoos, the Foundation also gave its official stamp of approval to zoos as valid educational resources for upper grade students.

This legitimization of zoo education for more sophisticated instruction at the middle school and high school levels should not be taken lightly. Concurrent with the lack of exciting curriculum materials for this age group had been a long standing reluctance on the part of teachers to make zoo trips a legitimate part of the curriculum. Excuses ranging from rigid curricular requirements, lack of time, buses and money abound. Obscured by these excuses is a fairly complete ignorance of the enormous potential that can be derived from well orchestrated zoo lessons. But what teacher will willingly admit to such ignorance? The teachers are not to be blamed, of course. It is the system that places them in the role without giving them the proper support, background and preparation to teach the sciences. Even "soft" sciences like biology are not exempt.

How could we get across to teachers the notion that the study of zoo diets and animal dentition, for example, had everything to do with students' understanding of the workings of the digestive system, or that close-up observation of animal feet, hooves and claws would go further than textbooks in creating an understanding of structure and function, adaptation and evolution? How could we convince them that topics such as environments, climate, adaptations, animal behavior, nutrition, human impact on habitats and zoo management are germaine, indeed crucial, to a total comprehension of biology?

Quite simply, we decided to invest a great deal of effort, creative energies, staff time and financial resources to develop an instructional package that singlemindedly focuses on only one question:

"Will wildlife as we know it survive in the 21st century?"

The WIZE program is based on the belief that zoos can serve as the key to reawaken the interest in life sciences. By its generic nature the WIZE program has made zoo collections across the nation accessible as living laboratories. A significant aspect of the program is that it was designed to fit in so many settings. It coordinates well with the curricula of many states and with zoos of varying sizes, collections, locations and staffing patterns. Most of all, WIZE serves as a new link between zoos and a previously untapped audience of middle school students whose flickering interest in biological science can be captured and nourished.

Adolescence is a crucial stage in which values and ethics develop and crystallize. By capitalizing on natural fascination with animals and by presenting relevant and challenging issues, the program captures the adolescent's interest. And once the interest is awakened and attention focused, half the battle is won. WIZE builds on the idealism of adolescents, and attempts to influence their attitudes before they harden.

The WIZE program helps students and teachers explore the key question by examining the survival of animal species on land, in the air, and in the water. Through coordinated use of local zoos and a series of nearly one hundred exciting classroom lessons, students re-discover the joy of science as they tackle challenging ecological problems.

What are the specific objectives of the WIZE program?

1. to contribute significantly to student content acquisition in the life sciences via an integrated study of wildlife biology in the classroom and in the zoo

2. to enhance student interest in whole animal biology by providing an enjoyable , highly motivating program , based on the study of vertebrates

3. to increase students' long range concern for conservation by laying a basic groundwork of understanding of vertebrate diversity, adaptations , behavior, population dynamics and the role of zoos

4. to enrich the teachers' repertoire by providing a program which is enjoyable to teach and which provides a structured, yet easy-to-use method for using zoos as laboratories for biological investigations.

5. to develop a model for in-service training of teachers in the use of zoos as resources for inquiry learning

6. to provide a curriculm, or a flexible curriculum supplement, which is compatible with subject matter currently included in (or mandated by) existing middle school life sciences curricula

7. to foster a significant cooperative effort between zoos and local schools by making available to zoos, regardless of their staff size or budget, a tested program that enhances the use and interpretation of the collection

8. to provide a high quality program adaptable to a wide range of zoo collections

It would have been impossible to achieve such lofty objectives without the work of many dedicated zoo and education professionals. As I have already stated, WIZE was an investment. But it represents not only an investment of Bronx Zoo resources and energies. Had it not been for the cooperation of a consortium composed of zoos, local advisory panels, teachers and administrators from seventeen states WIZE could not have been created. Had it, in the final analysis, not been for the vision and financial investment of our publisher- Dale Seymour Publications- WIZE would not be available to a nationwide audience of teachers and zoos.

Although it is impossible to acknowledge all the individuals who assisted us over the four year period of development, testing and revision, several deserve to be singled out. The original members of the WIZE consortium: Ron Kaufman of the "world famous" Topeka Zoo, Don Winslow of the sparkling Riverbanks Zoo in Columbia/South Carolina, Kathy Wagner and Janet Jackson of the venerable Philadelphia Zoo. Joining us later on as satellite test sites were the Audubon Park Zoo in New Orleans and the Caldwell Zoo in Tyler, Texas under the able leadership of Debra Bressler and Cindy Denney, respectively. At various points in the program the Abilene Zoo, the Hawaii Zoo and the Detroit Zoo also invested staff time and expertise to help make WIZE replicable in a multitude of zoo settings. A special note of thanks to the directors of these institutions and to the hundreds of classroom teachers who are , by far, the largest group of " investors" in WIZE.

What is the significance of WIZE?

The significance of WIZE lies in the fact that it is the first nationwide effort to coordinate formal classroom instruction with the use of zoos. There are two important facts to consider. First, few teachers above the elementary level have the motivation or the technical competence to incorporate wildlife studies as a regular part of the school's life science curriculum. Second, even if all the teachers did have the necessary motivation and training, zoos still could not provide adequate instructional services for all the potential middle school users. Thus, we are faced with a potential dillema. Whose responsibility is it to educate the masses of adolescents in issues of wildlife survival?

In this respect WIZE fills a vaccum. On one hand, it provides teachers with the motivation to incorporate wildlife studies as part of the *regular classroom curriculum*. How?- by placing in their hands a well integrated, easy-to-implement, non-threatening curriculum package that does not require expertise in zoology. On the other hand, it relieves overburdened zoo educators of the responsibility to provide direct instruction on a class-by-class basis and frees them to guide greater numbers of teachers in using the zoo collection to its maximum potential.

It is well known that multiple positive experiences with wildlife studies are needed, in order to influence students attitudes in a significant way. By asking the classroom teacher to do the bulk of instruction (12 to 15 weeks), zoo educators are freed to deal with a multitude of other tasks. Through the fifty classroom lessons and three, day-long zoo trips per module, WIZE is sufficiently intensive to make a meaningful contribution toward fostering of positive attitudes and developing a conservation ethic of long lasting value. All this, without consuming hundreds of person-hours of zoo educators' time. The classroom teacher does the investing, the zoo educator reaps the benefits.

WIZE consists of two modules which can serve students in grades 6-12.

Diversity of Lifestyles allows students to explore the survival of the individual animal. It focuses on the natural habitats of the world and on how wild animals are adapted to meet the survival challenges posed by those habitats. This module is composed of three units: **Animals of the Land, Animals of the Air and Animals of the Water**.

Survival Strategies, the program's second module, asks students to think about more complex issues. It focuses on the survival of animal populations and communities, and on the role of zoos and wildlife reserves in sustaining these populations. The three units of this module, still in the prototype stage, include: **Life Cycles**, **Predation and Competition** and **People and Wildlife.**

Each module consists of a set of teacher materials and a complete classroom set of student materials. The most important element of the kit for the teacher is the **Teacher's Manual**

- this guide details lesson plans in a format teachers find easy to use. Lesson aims, objectives, motivation, materials, lesson procedure, homework and new vocabulary are included. Technical information and complete answers to all student questions, problems and worksheets supplement each lesson plan, and give even a non-science specialist complete support.

There are also two essential kit components for the students. These include 208 laminated **Discovery Cards**

- the classroom set includes 8 copies of 24 different card titles. These illustrated, cards serve as springboards into the lessons. They pose fascinating wildlife survival questions and present problems which lead into stimulating discussions in a guided search for solutions. Several cards are designed especially for use in zoos.

The main information source for the students are the **Student Resource Books**

- the classroom set includes 34 copies of each book. These richly illustrated books are closely tied to the discovery activities. Bold type highlights key ideas and chapter summaries help in reviewing the main points. A glossary defines new terms and helps expand the students' science vocabulary.

Rounding out the kit are the **Student Worksheets** and **Photo Cards**

- 30 different worksheet titles are provided on black line masters. These worksheets often accompany discovery activities and provide a structured means for students to solve problems, compile observations, or tabulate results of simulation games.
- 20 black and white photographs serve as valuable visual aids. They assist students in seeing and comprehending the fine structure of interesting animal parts.

In addition to the above, module two features a **Survival Strategies film strip**, **sound cassettes** with animal vocalizations and a sophisticated zoo and reserve management simulation entitled **Postrerity**.

To ensure that the investment of time and money was sound, WIZE has been tested with 167 teachers and approximately 13,000 students in 16 states. The program has undergone close scrutiny in a two stage evaluation designed in consultation with a professional evaluator.

Hundreds of classroom and zoo activities were tried out and honed through the formative and summative evaluation stages over a period of four years. A great deal of time was invested in designing appropriate teacher feedback forms, questionnaires, student content tests, and opinionnaires to assess attitudes.

All drafts of the materials were systematically reviewed by consortium members, and by many members of the zoos' curatorial and scientific staffs. This assured scientific accuracy and relevance to zoo concerns. The materials were also reviewed by special curriculum consultants, school boards, and district administrators from many states. The final package is the result of collaborative investment of effort by a unique combination of professionals.

One of the dictionary definitions of the word **invest** is *to endow with power or authority*. We hope that WIZE will endow teachers with the power to use zoos effectively and zoos with the authority to expect positive actions by the adults of the future, the adolescents of today. If profitable returns are evident in the 21-st century we will be able to determine the wisdom of our collective investment in WIZE.

GETTING INTO THE BLOODSTREAM: INTEGRATING SCHOOL CURRICULUM AND ZOO EDUCATION

Debra L. Bresler
Curator of Education
Audubon Park and Zoological Garden

Will wildlife as we know it today survive in the 21st century? At the present rate of extinction, the survival of wildlife rests in our hands. We are zoo educators, and it is our responsibility to instill positive attitudes towards wildlife to insure its future survival.

But, where do we begin, and how can we affect such attitude changes?

As zoo educators we educate first those who visit our zoos and aquariums. An estimated 110 million people visit zoos annually in the United States. Of this total, an estimated 10 to 15% are school group students.

For those students who visit the zoo, each of our facilities offers a variety of interpretive programs and other activities -- guided tours, amphitheater shows, or animal demonstrations -- designed to encourage an interaction and understanding of wildlife during the zoo visit.

Many zoos and aquariums offer outreach programs which prepare students for their visit to the zoo. Multi-discipline fact sheets are also provided to enhance the zoo visit.

For these students the zoo is an educational resource. But, how do we reach those students who do not visit our facilities?

The U. S. Department of Education National Center for Educational Statistics reports an enrollment of 44,000,625 students in pre-kindergarten through 12th grades. If 16,500,000 school group students visit a zoo or aquarium annually, this means that 27,500,625 students do not visit our facilities and are not being directly affected by the conservation education efforts directed by our zoos and aquariums. How do we reach these students? How do we instill an appreciation and understanding of the need for wildlife conservation?

We must get into the bloodstream! We must become more than an educational resource or enrichment facility. We must become an integral part of the curriculum.

Where do we start? How do we reach these 27,500,625 students?

Let's begin by examining the goals of the local school systems.

Most school systems have established a set of goals and objectives designed to provide guidelines and measures for teaching specific concepts in each discipline for each grade level. In New Orleans Public Schools such goals are called "expected learner outcomes".

For New Orleans Public Schools the expected learner outcome targets the study of endangered species for the fourth grade life science unit. With the aid of activities and materials outlined on this page, the concept of endangered species is merely introduced. But, can it actually be taught through such a cursory introduction? Those students who have had the opportunity to visit the zoo or aquarium can perhaps recognize the vanishing animal symbol used on designated exhibits or have participated in other interpretive programs about conservation at the zoo. But, how do those students who have not visited the zoo truly recognize and feel the impact of vanishing animals on their future? And why should such a vast concept be restricted to the science curriculum?

At the Indianapolis Zoo, what began as an idea to develop interdisciplinary endangered species teacher resource kits grew into a major cooperative project with Indiana zoo educators and the Non-Game and Endangered Wildlife Department, a division of the Indiana Department of Natural Resources. The Fort Wayne Children's Zoo, Mesker Park, Columbian Park and Washington Park Zoos are working together to develop and implement such kits for 3rd through 12th grade students in the state of Indiana. After evaluation and testing of the seven kits is conducted, additional funding could be secured to develop and place even more kits in the school districts. Such a program could impact 964,489 public school students. This figure can even be increased to include students in the private and parochial schools of the districts.

In a major cooperative effort, the educators of the Akron, Cincinnati, Cleveland, Columbus, and Toledo Zoos, Sea World of Ohio, Wild Animal Habitat at King's Island, and the Good Zoo, are developing a multi-disciplined endangered species curriculum for the state of Ohio as a part of the kindergarten through 12th grade conservation program. This curriculum will incorporate the state requirements. Implementation of this program will be accomplished through teacher in-service and could reach thousands of students.

In-service programs can be an effective means of reaching thousands of students who may not visit the zoo or aquarium. For every teacher who participates in an in-service program, we can reach 20 to 30 students. Traditionally, in-service programs train teachers to use the zoo or aquarium as a classroom. Teachers are provided with materials that can be useful in planning effective educational field trips and self-guided tours of these facilities. The purpose of the in-service program must be expanded however, to train teachers, curriculum supervisors, and administrators to develop and utilize conservation education units in the classroom.

Individual conservation programs have been developed as self-contained units of study about wildlife conservation. Such units provide students with a more in-depth study of the desperate plight of endangered species. Through in-service programs the use of such units can be encouraged and demonstrated. Though other units are available, I will name only a few with which I am most familiar.

The New York Zoological Society has developed an innovative and flexible life science curriculum called W.I.Z.E.--Wildlife Inquiry through Zoo Education. W.I.Z.E. helps students in grades K - 12 deal with critical wildlife survival issues, as it enhances the study of science by its interdisciplinary perspective. At a minimal per pupil cost, every W.I.Z.E. teacher receives a comprehensive set of attractive materials for 12 to 15 weeks of instruction. W.I.Z.E. fits easily into any program as a self-contained curriculum package in biological sciences or as a flexible supplementary program.

World Wildlife has developed a new conservation education program entitled Future in the Wild. Though originally designed for use on the site of a zoo, aquarium or botanical garden, Future in the Wild is currently being expanded to include a teacher guide which demonstrates how to use the program materials in the classroom.

Wildlife Education, Ltd., publishers of ZOO BOOKS, has developed an interdisciplinary "Endangered Animals Teaching Unit". This unit, designed to increase awareness of the animal kingdom, interacts with the Endangered Animals ZOO BOOK. The Endangered Animals Teaching Unit solely addresses the issue of what is happening to our wildlife, why it is happening, and what we can do.

Individual schools whose teachers have a special interest in wildlife conservation could consider "webbing" their own curriculum.

In the November 1984 issue of Science Scope,[1] a supplement for middle and junior high science teachers published by the National Science Teachers Association, introduces the concept of "webbing", an integrated science program. Margaret Steinheimer, a middle school teacher from St. Louis and author of the article, maintains "interdisciplinary units are an integral part of most middle school curricula. When each teacher teaches a topic from the perspective of his or her subject area, students can see that all of life is interrelated, and no one area of learning can stand alone."

To develop an interdisciplinary unit she implements a method of organizing ideas called "webbing". The webbing technique uses two general steps. The first step involves making a diagram in which the chosen topic is written in the center of the paper with all of the areas of study to be involved in the unit positioned around the outside. Step number two involves adding the specific materials to be covered in each general subject area. The teacher of the subject area to which the general topic directly relates--which in the case of wildlife conservation is science--needs to devote more time to the unit than others. This teacher also serves as the "director" who ensures that all teachers coordinate their efforts within a given time frame.

The culminating event is a high point of an interdisciplinary unit. "Nothing can bring together the entire facility of a school and instill enthusiasm in students like a true interdisciplinary unit," Steinheimer concludes.

Individual multidisciplinary programs can also be developed by zoos and aquariums and sponsored by local corporations. Such programs are easily implemented into the curriculum cooperatively by the zoo and appropriate curriculum supervisor as a "webbing" activity or can be used as independent curriculum programs or projects.

The Audubon Zoo sponsored two such independent curriculum programs designed to target the discipline of language arts.

Read-the-Zoo, a reading certificate program designed to encourage students to read non-fiction books about animals, encourages reading by providing a stimulating subject--animals--as it enhances reading skills. Over 50,000 students within a twelve parish (or county) area registered for Read-the-Zoo this year. Not only did these students improve their reading abilities, but they also received a deeper appreciation of animals.

"If I were a vanishing animal" is the theme of the creative essay contest. Seventh and eighth grade students are encouraged to submit creative essays which explore the plight of endangered native and exotic species. Essays must begin with the phrase "If I were a vanishing animal...", thus requiring the students to walk in the animals' tracks--to experience a threatened existence. Essays are judged on the basis of attitude toward subject matter, integration of accurate factual information and fantasy, content and style, first person narrative, creativity usage, punctuation, spelling, and neatness, thus reinforcing the targeted objectives of the school systems.

Math, art, social studies, history, music, and other disciplines can be tapped as the basis of individual curriculum programs, projects, or contests which explore and bring to life the concepts of conservation.

Extinctions have always occurred and new species have appeared. But, species are now disappearing much faster than they can be replaced. In fact, species are now becoming extinct 50 times faster than they did before. If the rate of extinction continues to increase, one out of every five species alive today will have become extinct by the year 2000.

For our wildlife the prognosis is bleak. We must get into the bloodstream and become an integral part of the daily curriculum. Only through such interaction can we imprint an indelible reminder about the desperate plight of wildlife around the world.

The goal is survival; the task is ours.

We cannot skip a beat!

Endnote

1. Steinheimer, M., 1984. Webbing an Integrated Science Program. Science Scope. Vol. 8 No. 2. I: 10-11.

IN-HOUSE ANIMAL INVENTORY RECORDS SOFTWARE

Nate Flesness and Paul Scobie
International Species Inventory System

In-house computerized animal inventory records have been wished-for for years. This was one motive for initiation of ISIS back in 1973, and the problem has been worked on in the interim by quite a few institutions.

Several have some kind of system now in use. These range from simple file-management systems which require the user to know the software tool, and which perform simple searches and reports, all the way up to large mini and mainframe systems with diverse capabilities. Three facilities have investments over $100,000 each in creation of such systems. All of these projects have been quite challenging. Only two have yet reached the level of sending data on to ISIS, and only one of these presently has a lower error rate than the average user of ISIS' paper forms.

ISIS has wanted to tackle this problem for some time. In 1982, a mailing was sent to all ISIS participants, in the hope of developing a consensus to work on the problem jointly. This was unsuccessful - few institutions responded positively.

In February of 1984, serendipity intervened. The New York Zoological Society, and the Zoological Society of Chicago - Brookfield, agreed to co-sponsor part of the costs of such a joint development effort. The Office of Information Resource Management of the Smithsonian Institution volunteered to do the same, and an Institute of Museum Services Conservation Program grant for matching funds was obtained by ISIS.

With funding in hand, Paul Scobie was added to the ISIS staff as System Developer some fourteen months ago (1 July, 1984). We then proceeded stepwise to choose the hardware (microcomputers, specifically IBM PC's and compatibles). This choice was driven the popularity of this standard, and because the needed database management system software tools were strongest for these machines.

A dozen available database management systems were explored and tested, and Dbase III from Ashton-Tate chosen as one of the top two available - and the one in widest use.

We then visited New York, Brookfield, and National zoos, discussing what the system should do with registrars, curators, keepers, and even directors. After this, preliminary system design was done, and programming started in December, 1984.

After a rough system was built, another review took place in March, 1985 at the National Zoo, during a two-day workshop sponsored by Friends of the National Zoo, including representatives from Brookfield and New York.

By the end of June, a superficially working system was completed. Initial testing took place in the ISIS office during July, finding "bugs", changing commands for clarity, etc. We had initially promised the co-sponsoring institutions that they would be fully involved in the testing process, so before we had completed very extensive testing we recruited their help.

A month ago, the first week of August, test systems and preliminary instruction manuals were distributed to our sponsors and a few other facilities especially appropriate for testing. Each was provided already loaded with all data sent to ISIS by that facility over the years. In New York's case, this amounted to data on over 9,000 specimens going back into the 1960's. This already-loaded data really helps the test process, as reports can be produced immediately, and each institution works with a considerable quantity of their own information right away. Of course it is also quite a convenience for actual use of the software as well.

As expected, some "bugs" have been found, and some recommended changes suggested by our test sites. This was fully expected, and was precisely the reason for the testing. A new release of the software was mailed out on 1 September, incorporating some of the new ideas and fixing bugs identified so far.

Testing will be continued for another couple of months, and the manual finished with emphasis on areas that were unclear to our test users. Then we will announce availability. Key features of the ARKS system include:

1. It can be used by computer novices.

2. Species are identified by scientific name or genus-level common name, institutions by mnemonic abbreviations.

3. It has extensive quality-control on inventory records
    a. 10,000+ name taxonomic dictionary
    b. 1,000+ name institution dictionary
    c. transaction logic checked (i.e. can't sell a specimen in-on-loan, etc.)
    d. parents checked for right taxon, right sex, etc.

4. It takes care of ISIS reporting automatically

5. Specimen reports on demand

6. Taxon reports on demand

7. Collection reports on demand

The following general information on the in-house software is presented in lieu of the live demonstration given at the conference.

ISIS' new Animal Records Keeping System (A.R.K.S.) is a way to maintain and utilize animal inventory records on a microcomputer. It consists of a set of programs (software) which assist you in recording births, deaths, loans, purchases, sales, etc., and can record cage log information and other comments, if you wish.

The system's initial version offers 3 kinds of reports available to you at any time. They are described below; samples are included at the end.

1. Collection Inventory Report. Similar to the annual report produced by many facilities, this is an extensive 8-column tabulation, species by species, of holdings and changes. It can be produced for the traditional 1 January to 31 December period, or for any other time interval (e.g. monthly, or for the last 10 years).

2. Taxon Report. This provides much more detail on the Genus, Species, or Subspecies you choose. It provides a review of the basic facts about each specimen within the taxon, including age, sex, parentage or source, and last removal. It can be limited to just those specimens on inventory as of a given date, or can be controlled to include earlier, historical data, if you wish.

3. Specimen Report. This provides all available information on the chosen specimen. You may choose the specimen by indicating it's accession number, or by entering the name of the species and house name, tag/tattoo, or band identification. This report shows the basic biological facts about the animal, its complete transaction history, enclosure history (if recorded), etc. It provides an excellent shipping report as well.

In addition to these reports, the system automatically takes care of ISIS reporting. For specimens reported to ISIS (the user controls which), the equivalent of paper ISIS data forms are written to a "file" in the microcomputer. Periodically forwarding this file to ISIS (by floppy disk, or telecommunication) is all that is required for ISIS participation - making this enormously easier.

Numerous additional reports are planned for a later version of A.R.K.S. These include:

1. Loan Report
2. Cage Log
3. Age Pyramid
4. IZY Questionnaire Report
5. WPO Report
6. Reproductive History
7. Pedigree - local
8. Inbreeding - local
9. Endang. Species Report
10. PPEQ Repo
11. Fecundity
12. Mortality

ARKS SPEAKS ENGLISH

The A.R.K.S. system speaks English and Latin (scientific names). A German language version is under development. The system does not use the traditional ISIS 16-digit numerical taxonomic codes, but instead uses scientific names. If these are mispelled, the user is helped to the right one. All scientific names are checked against a 10,000 name dictionary, containing scientific names for all taxa of mammals, birds, reptiles, and amphibians known to have been held in captivity. In the rare case of a never-before held species, there is a mechanism for adding additional names to the dictionary. Instead of scientific names, genus-level English common names can be entered. Considerable capacity for synonyms is available - the user can establish those needed or convenient (i.e. entering "GLT" (for Golden Lion Tamarin) gets you directly to *Leontopithecus rosalia rosalia*.

A similar approach is used for recording the names of other institutions. The system includes a dictionary of about 1,000 institutions, with abbreviations of up to nine letters. Institutional synonyms are supported and many are included. Thus entering "New York", or "Bronx", or "NYZS" is equivalent - any of these will be stored and reported as "NY Bronx"; similarly, entry of either "Artis Zoo" or "Amsterdam" will be stored as "Amsterdam".

DATA QUALITY

The system assists records accuracy. Many edit-checks are built in, so that biologically unlikely events (e.g. the sire is a female, the dam is another species and the individual was not a hybrid, etc.) or legally undesirable events (e.g. sale of an animal in-on-loan) are pointed out immediately.

BEYOND PRESENT SCOPE

The A.R.K.S. software does not do everything in animal records. Veterinary records, pathology records, diet, behavior, reproduction, research, etc. are beyond its present scope. Limited amounts of these kinds of information may be entered as comments, and a comment-coding scheme may be designed by the individual institution. It seemed desirable to have a sound, functional, inventory records system first, and then see about further extensions.

As mentioned above, considerable expansion of the number of reports available from the inventory records system is planned during 1986.

NECESSARY COMPUTER EQUIPMENT

A.R.K.S. was designed, after considerable thought, to operate on IBM PC's and compatible machines. It requires a "hard disk", as it is too large to operate from floppy disks. Minimum memory requirements are 256K (more is better).

At least for now, A.R.K.S. users will have to have a copy of Dbase III from Ashton-Tate. This is available for well under $400 at present, from mail-order houses.

A printer capable of wide-paper printing or condensed type is recommended as some reports require the extra width. Dot-matrix printers such as those made by Epson work fine; the printer control codes to switch to condensed print may be installed by the user.

AVAILABILITY

There will be a fee for loading data and custom-preparing A.R.K.S. - with revenues going to help provide support and improvements. The price will be $500.

Included in this cost will be custom-installed data. A.R.K.S. is provided to each zoological facility with some data already entered - everything the facility has ever reported to ISIS. In the case of the New York Zoological Society, this amounts to records on 9,000 animals.

FURTHER INFORMATION

Please write or call ISIS for further information, if needed.

ISIS
12101 Johnny Cake Road
Apple Valley, MN 55124
Telephone 612-432-9010 (voice); 612-432-9292 (BBS)

```
Removed:                      Specimen Report                   Report Date:
 6 Jun 1985       NZP DEPTS. MAMMALOGY, ORNITH. AND HERP.        25 Sep 1985
==============================================================================
Taxon Name: PTILONORHYNCHUS VIOLACEUS                 Accession Number: 200199
Common Name: SATIN BOWERBIRD                          Acc. Date:    6 May 1971
==============================================================================
                                                      House Name:
                 Sex: Female                          Tag/Band: RED RT
                                                      Tattoo:
Original Acquisition: Acq. from Another               Age: 15Y at removal

          Birth Type: Unknown
      Birth Location: ___________
          Birth Date: 05/05/70 Est.to year
                     (DD/MM/YY)
               Terms: Purchase
              Vendor: SYDNEY    TARONGA ZOO AND AQUARIUM
     Vendor Spec. ID:     UNK

Transaction History >>>

#  Terms/Party       Their Spec. Id     Date(DD/MM/YY)       Price     Delivery
-------------------------------------------------------------------------------
1  Purchase
       SYDNEY          UNK              06/05/71
2  Donation to Another
       NZP-CRC     200199               21/06/84
3  Donation to Us
       NZP-CRC     200199               31/05/85
4  Death
       by Other/Unknown                 06/06/85          15Y Est.

Special Data & Comments >>>

#  Code/Text                                                     Date(DD/MM/YY)
-------------------------------------------------------------------------------
1  Tag/Band                                                      31/05/85
       RED RT
```

```
Report Start Date:               Taxon Report                Report End Date:
 1 Sep 1985       NZP DEPTS. MAMMALOGY, ORNITH. AND HERP.          1 Sep 1985
==============================================================================
Taxon Name: PTILONORHYNCHUS VIOLACEUS
Common Name: SATIN BOWERBIRD
==============================================================================
Identification:                      Dates:        Terms:        Sire Id / Dam Id
Spec.Id House/Tag/Tattoo Sex/Age     Birth/In/Out                Party:  Their Id
-------------------------------------------------------------------------------
 205995                   Male     ~30 Aug 1975 Wild born        SYDNEY
                                    30 Aug 1979 Loan to Us       SANDIEGOZ 203152
                          ~10Y
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 206269                   Male      17 Jul 1980 Captive born    205995 200199
                                    17 Jul 1980 Birth
                          5Y,1M,16D
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 207555                   Female   ~ 7 Oct 1981 Wild born        SYDNEY
                                     8 Oct 1982 Donation         BORGIA       UNK
                          ~3Y
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
 207557                   Female   ~ 7 Oct 1981 Wild born        SYDNEY
                                     8 Oct 1982 Donation         BORGIA       UNK
                          ~3Y
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

Current Inventory Summary as of Report End Date:
==============================================================================
 Totals: 2.2.0 Animals                1 Captive Born
             1 In on Loan             3 Wild Born
             0 Out on Loan            0 Birth Type Unknown
==============================================================================
                                Status of AVES Collection                          Page    1
Report Start Date:    NZP DEPTS. MAMMALOGY, ORNITH. AND HERP.    Report End Date:
 1 Jan 1984                                                                     31 Dec 1984
==============================================================================================
                                        Status    :           : Other    :  Deaths      ( < 30 days )    : Other      : Status     Grp
Identification                          01/01/84  : Births    : Acquis'n:               Births  Acquis'n : Dispos'n   : 31/12/84   Cnt
************************************************************************************************************************************
AVES
 STRUTHIONIFORMES
  STRUTHIONIDAE
   STRUTHIO CAMELUS (no subsp)          1. 0          0       0. 1         0   (     0        0  )     0          1. 1
    ostrich

 RHEIFORMES
  RHEIDAE
   RHEA AMERICANA (no subsp)            4. 3      0. 0. 5      0        0. 1   (     0        0  )  3. 1. 5      1. 1
    greater rhea

   RHEA AMERICANA ALBESCENS               0           0       1. 0         0   (     0        0  )     0          1. 0        79
    rhea

   RHEA AMERICANA AMERICANA               0       0. 0. 1      0           0   (     0        0  )     0          0. 0. 2
    greater rhea                                - 0. 0. 1

 CASUARIIFORMES
  CASUARIIDAE
   CASUARIUS CASUARIUS BICARUNCULATUS   1. 2        . 0        0        0. 1   (     0        0  )     0          1. 1
    double-wattled cassowary

  DROMAIIDAE
   DROMAIUS NOVAEHOLLANDIAE (no subsp)  1. 1          0        0           0   (     0        0  )     0          1. 1
    emu

 APTERYGIFORMES
  APTERYGIDAE
   APTERYX AUSTRALIS MANTELLI           1. 0          0        0           0   (     0        0  )     0          1. 0
    brown kiwi

 PODICIPEDIFORMES
  PODICIPEDIDAE
   PODICEPS AURITUS                       0           0     0. 0. 1   0. 0. 1  (     0     0. 0. 1)    0          0. 0
    horned grebe

 PELECANIFORMES
  PELECANIDAE
   PELECANUS ONOCROTALUS                  0           0     0. 0. 2        0   (     0        0  )     0          0. 0. 2
    eastern white pelican

  PHALACROCORACIDAE
   PHALACROCORAI AURITUS (no subsp)     2. 2. 3   0. 0. 1      0      0. 0. 1  (  0. 0. 1     0  )     0          2. 2. 3
    double-crested cormorant

 CICONIIFORMES
  ARDEIDAE
   NYCTICORAI NYCTICORAI                0. 0. 9       0        0      0. 0. 1  (     0        0  )     0          0. 0. 8
    black-crowned night heron
```

431

```
                                Status of AVES Collection
Report Start Date:   NZP DEPTS. MAMMALOGY, ORNITH. AND HERP.   Report End Date:
 1 Jan 1984                                                        31 Dec 1984
==============================================================================

Summary:

                          Specimens Owned   Specimens Owned   Specimens Not Owned
                          at institution    on Loan Out        on Loan In
                          ===============   ===============   ==================
Status  1 Jan 1984              706                1                19

Births                           54                1                 1

Other Acquistions               164                0                 8

Deaths                          219                0                 2

(Deaths < 30 days)               11                0                 0
( of Birth        )
(Deaths < 30 days)               13                0                 0
( of Other Acq.   )
Other Dispositions               62                0                 3

Status 31 Dec 1984              646                1                23

Total Specimens owned by NZP-WASH:          647

Non-Accessioned Group Counts:           79

Legend:
  1.1.1 = specimen counts as males.females.unknown sex
 -1.1.1 = specimens on Loan Out from NZP-WASH
 +1.1.1 = specimens on Loan In to NZP-WASH
```

BEST COPY AVAILABLE

A SURVEY OF RECENT DEVELOPMENTS IN ZOOLOGICAL INFORMATION MANAGEMENT

Alan F. Rost
Information Specialist
Dickerson Park Zoo
Springfield, Missouri

Today, I would like to survey three of the information intensive positions that have arisen recently and present some history and theory behind why these positions are becoming more dominant in your institutions today.

One of the more successful and widely read books of the last five years was the 1982 publication, MEGATRENDS: TEN NEW DIRECTIONS TRANSFORMING OUR LIVES, by John Naisbitt. The first chapter of this title discusses the development of today's information oriented society and its technology. When viewed with a zoological perspective, this chapter can provide some basic theory behind why there are growing numbers of the information intensive positions of librarian, registrar, and information specialist within the zoological community.

The current development of an information oriented society can be traced to the mid-1950s. The year 1956 saw the inaugeration of transatlantic cable telephone service. Also in 1956, for the first time in American history, white-collar workers in technical, managerial, and clerical positions outnumbered blue-collar workers. Next, in 1957, the missing technological catalyst in a growing information society was provided when the Russians launched Sputnik. The real importance of Sputnik is not that it began the space age, but that it introduced the era of global satellite communication. Satellites have transformed the earth into what Marshall McLuhan has called a global village.

Today's information technology - from computers to cable television - did not bring about the new information society. It was already well underway by the late 1950s. The problem is that our thinking, attitudes, and, consequently, our decision-making have not caught up with reality. The level of change involved is so fundamental, yet subtle, that we tend not to see it, or if we see it, dismiss it as overly simplistic and to be ignored. Yet, we do so at great risk to our organizations and our careers. Without an appreciation of the larger shifts that are restructuring our society, we act on assumptions that are out of date.

The period we are currently living through, termed by Harvard sociologist Daniel Bell as the "post-industrial society", is the information society. Occupations in information have seen staggering increases. In 1950, only about 17 percent of the work force dealt with information. By the 1980s, more than 60 percent of us work with information as programmers, teachers, clerks, secretaries, accountants, stock brokers, managers, insurance people, bureaucrats, lawyers, bankers, and technicians. Most Americans spend their time creating, processing, or distributing information. It is important to acknowledge the kind of work we do, because we are what we do, and what we do shapes our society.

In the industrial society, the strategic resource was capital. But in this new society, as Daniel Bell first pointed out, the strategic resource is information. Not the only resource, but the most important. With information as the strategic resource, access to the economic system is much easier. In the information society, we have systemized the production of knowledge and amplified our brainpower. We now mass-produce knowledge, and this knowledge is the driving force of our economy. Knowledge is not subject to a law of conservation. It can be created or destroyed, but most importantly, it is synergetic - the whole is usually greater than the sum of the parts. Peter Drucker notes that, "The productivity of knowledge has already become the key to productivity, competitive strength, and economic achievement. Knowledge has already become the primary industry, the industry that supplies the economy the essential and central resources of production". In an information economy, value is increased, not by labor, but by knowledge. For the first time, we have an economy based on a key resource that is not only renewable but self-generating.

In this new information society, the time orientation is to the future. The pace of change is ever more accelerating as communications technology collapses the "information float" - the amount of time information spends in the communication channel. A letter sent by mail takes days, but sent electronically takes only seconds, thereby collapsing the information float. The life channel of the information age is communication.

Mr. Naisbitt's work can be extended to the zoological community as a smaller unit of our larger society. Three of the most direct reactions have been the development of the staff positions of librarian, registrar, and information specialist. The dominant responsibility of each of these three positions is information management, and this fact is directly responsible for their recent, fairly rapid growth within the zoological world. In the world surrounding our zoos, the production of knowledge has already been systemized. Naisbitt indicates this production has become the key to our productivity and competitive strength. It has also become self-generating at an accelerating rate. This accelerating self-generation of information affects us all, directly. How can management make correct, informed decisions, based on the most appropriate and timely information, when the level of information is so great as to be unhandleable by normal means. Then, uncontrolled and unorganized, information is no longer a resource, but the enemy. Information technology helps to bring order to this chaos, and the information scientist helps to show the way. It is interesting that zoological institutions that appear in the forefront today all have full-time registrars and librarians (or information specialists) and are in the process of computerization.

Harold Borko, information science educator, defines information science as "The study of the properties and behavior of information, the forces governing the flow of information, and the means of processing it for optimum accessibility and usability". That definition serves well the oldest of these three information positions - the zoological librarian. Zoological libraries can be traced back to before Christ, but it is only within the last decade that zoo libraries and librarians have started to multiply. Although a handful of the larger zoos, such as the Bronx, National, and San Diego zoos, and a small group of others, can boast a proud and long professional tradition, only recently has the medium and small sized zoo considered the zoological librarian as a vital staff position.

Often, volunteers have started a library which gradually became more and more indispensible. Although many zoo libraries owe their existence to volunteers, this fact has also severely limited their effectiveness. Library science is a science in its own right and, typically, requires the appropriate specialized training for best results. It should be observed that the zoo library is a "special" library and will often have more in common with other special library types, such as law, medical, or business libraries, than with your public, children's, or academic library. This also holds true with your zoo librarian's background training. Ideally, they should be a graduate of an American Library Association accredited library science graduate school, with an emphasis in special libraries and a bachelor or masters in biology, zoology, or some other closely related area.

A successful zoo librarian will be aggressive in developing new sources of information to flow into the institution and will develop flow patterns for those sources within the institution. Information must first be available. An appropriately trained librarian will secure sources of information previously unknown to your institution. This is the one aspect that has amazed my own director on numerous occasions, and has confirmed in his own mind the importance of a trained librarian, irregardless of the size of the zoo. Your librarian, if allowed to be part of the management planning process, will often be able to look ahead and have needed information readily available prior to its need. Any one person can only cover so much material over any given period of time. A good zoo librarian will become your second pair of eyes on the zoo literature. Once pertinent information is inhouse, the librarian will then make it available or accessible in an optimum, usable format.

The zoo registrar is a much newer position. Originally known as a records' keeper, this position was also usually filled by a volunteer, or tacked on to some other position. Three events were directly connected with the development of the zoo registrar over the last fifteen years.

First, and probably most importantly, there was the ever growing entanglement of federal regulations that began in the 1960s, and continues to grow. Second, there was the beginning and growth of the International Species Inventory System (ISIS) during the 1970s. Third was the continual decrease of wildlife in the wild, finally resulting in the development of the Species Survival Plan (SSP) program. Each of these changes has significantly changed the records' keeper's responsibilities and focus. The registrar was now as much in service of administrative management as collection management.

The term of registrar is not new, but already well established with standards and ethics, as developed in this country's museums. The zoo registrar shares much with the museum registrar, beginning with the fact that the zoo is a living museum. At this point, the zoo registrar is a position that has arisen almost simultaneously at a number of institutions, with each registrar having varying responsibilities. Recently, a group of zoo registrars have begun to work together to identify what responsibilities they currently share, or feel they should share. By using the experiences of the much older profession of museum registrar, it is hoped to establish a concensus as to what areas of responsibility are central to any registrar position, how the zoo registrar should fit into the personnel framework for maximum effectiveness, and to establish a code of professionalism.

Although responsibilities may vary, a few generalizations can be made. Where a records' keeper is responsible for maintaining data vital to collection management, the registrar is equally responsible in service to administrative management. First and foremost, the registrar serves a monitoring function. This monitoring particularly extends to the areas of collection policy, including the collection's fiscal and legal status. At institutions with registrars, they are often responsible for animal transactions, permit applications, and loan agreements. The registrar also remains responsible for inventory control, but with as much of an eye to the needs of administrative management as to collection management.

The newest of the three positions is that of information specialist, which is a creation of the 1980s. It embodies the responsibilities of both the registrar and the librarian in one position for those zoos realistically too small for multiple, full-time positions. This is definitely a smaller zoo's position, since it would stagger under its responsiblities at a larger facility. At a time when society is moving from the specialist, who is soon obsolete, to the generalist, who can adapt, the information specialist in the smaller zoo may well represent one of the inevitable creations of the information society. The truly modern zoo of the remainder of this century will require the services of an "information broker" of some sort, and the supporting technology to actively participate on the zoological management team. To survive, the zoological institution will have to be information wise if it is to exist in an information society based on an information economy.

THE VALUE OF A COMPUTERIZED STUDBOOK PROGRAM

by Lee G. Simmons, DVM
Director
Henry Doorly Zoo

The stated purpose of studbook and SSP management programs is to assist institutions in the long term propagation of endangered species in a manner designed to preserve maximum heterozygosity and promote equal representation of founders. The problem with being a studbook keeper, or SSP species manager, is that despite all your ideas and good intentions about direction and ultimate goals, the realities of formulating and implimenting practical policies and programs for a species are never as easy as the enthusiasm of the moment made them seem when you volunteered for the job.

Setting aside the emotionalism and politics which can influence decision making in some highly visible species having strong local identities, the mechanics of compiling and editing for accuracy the volume of basic census data necessary for a species with even a moderate captive population spread over three or four generations involves a great deal of work. Reconformation and correction of records, whether down loaded from ISIS data originally submitted by institutions or gleaned from surveys sent to holding institutions, is the first and most critical step. Without accurate, complete, and pertinent data, reaching logical conclusions or making sound decisions is impossible. The data output is only as accurate as the data input.

Next to accurate data, the most important part of a genetic management program is deciding what the minimum data set for each animal should be. It must be small enough to realistically collect and handle, but complete enough so that nearly all other and more specialized data sets can be generated from it.

The amount of old fashioned human elbow grease with pencil and paper and the number of confirming questionnaires and telephone calls to first generate a database and then keep this minimum data base both historically and currently accurate is always a surprise. I should say more correctly a continuing series of surprises such as changes in sex, parentage, birth dates, and death dates. Studbook keepers dislike surprises (inaccuracies), computers hate them and they are disasterous in planning amd implementing long term genetic management programs.

It is at this point that a computer, coupled with a software program designed to both auto edit the basic data and generate most of the specialized reports and data sets needed to properly manage a studbook or management program becomes not only invaluable, but absolutely essential.

This becomes very apparent when you acknowledge two facts: 1) most of us involved with these critically important activities are not formally and primarily trained as genetisists, 2) there is simply not enough trained manpower available in the zoo world to generate by hand all the reports and data sets necessary for all the threatened and endangered species needing attention. The percentage of computer literate, let alone expert individuals in the zoo world is relatively small, and 3) if these many studbook and management programs are to be successful, they must not only be accurate in identifying animals parentage, birth dates, death dates etc., but they need to be consistent one to another so that not only studbook and species managers, but institution representatives can easily grasp and understand information and move easily from one species to another in the meetings and decision making processes which seem to occupy more and more of our time. From the view point of a species manager, a menu driven user friendly computer program can greatly assist in accomplishing all of this.

In the computer studbook program developed at the Henry Doorly Zoo and written by Randy Rockwell and Dr. Andrew Teare, the minimum data set for each animal record consists of 12 fields in a (dbase III[e]) database which conform both in location and size to the minimum data set currently used by Dr. Ulysses S. Seal for the Siberian tiger and shown below.

1 studbook #
3 sex
4 house name
5 birthdate
6 sire #
8 dam #
10 first location/owner one
11 first country
13 current location/location now
14 current country
15 current date
16 death date

From these, the program generates the 5 additional record fields shown below.

2 inbreed (coefficient of)
7 sire age (at conception)
9 dam age (at parturition)
16 death age
18 age type (A = alive
    D = # of days in death age
    M = # of months in death age

---

[e] Trademark of Ashton-Tate

A copy of the dbase III structure is included below.

```
Structure for database : E:GAUR.dbf
Number of data records :     346
Date of last update    : 09/03/85
Field  Field name  Type       Width      Dec
    1  STUDBOOK    Numeric        4
    2  INBREED     Numeric        3
    3  SEX         Character      1
    4  NAME        Character     15
    5  BIRTHDATE   Numeric        6
    6  SIRE_NO     Character      4
    7  SIRE_AGE    Numeric        3
    8  DAM_NO      Character      4
    9  DAM_AGE     Numeric        3
   10  OWNER_ONE   Character     15
   11  COUN_ONE    Character      3
   12  DATE_ONE    Numeric        6
   13  LOCAT_NOW   Character     15
   14  COUNTRY     Character      3
   15  DATE_NOW    Numeric        6
   16  DEATHDATE   Numeric        6
   17  DEATH_AGE   Numeric        3
   18  AGE_TYPE    Character      1
** Total **                     102
```

Additionally, the program generates (by requested year) census reports, % of founder representations, age specific mortalities, and age specific fertilities in both individuals and populations. In addition to calculating coefficients of inbreeding for an existing or theoretical animal and writing these values back into the database, the program will also draw a 5 generation pedigree chart for any existing or theoretical animal showing coefficients of inbreeding for the animal in question and each ancestor.

Listed below are the menus from which the programs are driven and the reports generated.

```
*************************************************************************
*                             STUDBOOK.PRG                              *
*                                                                       *
*          A MENU DRIVEN dBASE III PROGRAM TO MANAGE A STUDBOOK         *
*                                                                       *
*      ALLOWS EDITING OF RECORDS WITH AUTO-VERIFYING OF SOME FIELDS,    *
*   GENERATION OF VARIOUS POPULATION REPORTS, CALCULATION OF DEMOGRAPHIC *
*       PARAMETERS, INBREEDING COEFFICIENTS, AND PEDIGREE PRINTING      *
*                                                                       *
*                              WRITTEN BY                               *
*              Randall W. Rockwell & J. Andrew Teare, DVM               *
*                           Henry Doorly Zoo                            *
*                              July 1984                                *
*************************************************************************


ENTER THE NAME OF THE STUDBOOK SPECIES TO BE ACCESSED:
```

```
                 REPORT OPTIONS FOR GAUR POPULATION
===============================================================================

                        Reports from studbook
  .............................................................................
  ( 1)  HISTORICAL REPORT ON CAPTIVE POPULATION
  ( 2)  CURRENT REPORT ON CAPTIVE POPULATION
  ( 3)  CURRENT REPORT ON CAPTIVE POPULATION BY LOCATION
  ( 4)  HISTORICAL REPORT ON POPULATION BY LOCATION
  ( 5)  REPORT ACORDING TO SEX
  ( 6)  REPORT ON OFFSPRING ACCORDING TO DAM OR SIRE
  ( 7)  REPORT ACCORDING TO DATE OF BIRTH, DATE OF DEATH OR AGE AT DEATH
  ( 8)  REPORT ON BIRTHS OR DEATHS BY YEAR

                        Secondary menu options
  .............................................................................
  ( A)  MENU A - Append & edit programs and Demographic utilities
  ( B)  MENU B - Utility programs for auto-editing of studbook records

  ( D)  LEAVE THIS MENU AND RETURN TO dBASE
  ( Q)  QUIT - leave this MENU and RETURN to SYSTEM

INPUT OPTION DESIRED:
```

```
              UTILITY PROGRAMS FOR GAUR STUDBOOK MANAGEMENT
===============================================================================

                    Studbook Records - Add & Change
  .............................................................................
  ( 1)  APPEND - add new records to studbook
  ( 2)  EDIT - change records already in studbook

                         Demographics
  .............................................................................
  ( 3)  Report of AGE STRUCTURE by sex for inputed year
  ( 4)  Report of age specific MORTALITY/FERTILITY by sex (inputed years)
  ( 5)  Calculation of INBREEDING COEFFICIENTS from studbook
  ( 6)  CALCULATE age at death, & ages of sire & dam - update studbook
  ( 7)  Report of 30 day survival based on inbreeding coefficient
  ( 8)  Average inbreeding coefficient by location for given year
  ( 9)  Report Founder representations for given year (living herd)

                         Menu options
  .............................................................................
  ( B)  MENU B - Utility programs for auto-editing of studbook records
  ( M)  MAIN MENU - Report menu

INPUT OPTION DESIRED:
      AUTO-EDITING UTILITY PROGRAMS FOR GAUR STUDBOOK MANAGEMENT
==============================================================================

                      Auto-editing programs for studbook
   ............................................................................
   ( 1)  Self-consistancy check of Sire and Dam numbers
   ( 2)  Program to set up or change AUTHORITY FILE of recognized LOCATIONS
   ( 3)  Program to set up or change AUTHORITY FILE of recognized COUNTRIES
   ( 4)  Check date field on animals transferred to new location
   ( 5)  Left justify Sire and Dam number fields


                              Misc. programs
   ............................................................................
   ( 8) Indexing by studbook number, sire, dam, birthdate and deathdate
   ( 9) Change gestation length used by programs

                               Menu options
   ............................................................................
   ( R)  RETURN to previous menu
   ( M)  MAIN MENU - Report menu

INPUT CHOICE DESIRED:
```

```
                    Location Authority File - Menu Options
     ......................................................................

              [E]   Edit existing record

              [D]   Delete existing record

              [U]   Undelete record

              [R]   Replace all incorrect locations in studbook -
                        this may take some time

              [A]   Append new location

              [L]   List authority file

              [X]   Exit this menu - return to master menu

               Your choice please:
```

As previously mentioned, the auto editing programs to check that all animals listed as sires are actually males, that parents are not younger than offspring, that a studbook #1 assisgned to only one individual, are as important as the report programs.

Three of the reports generated: age specific mortalities, age specific fertilities and current age classes by sex, provide data for the demographics spread sheet program developed by Seal and Foose. With a minimum of data entry work, this program will provide a ten year projection of population numbers and sex ratios based on the history of deaths and births plus current population statistics. This spread sheet program also provides for demographic modeling by simulating age class harvesting etc. Plugging the gaur data from the Omaha Studbook program into the spread sheet program gives a projection of 294male and 271female gaur by September 1995. Obviously, either several new facilities must be found, current facilities greatly expanded, or management policies to limit growth instituted if severe over crowding is not to result.

Additionally, this year's gaur report shows founder representation in the North American herd ranging from 0.9% to 22%. The ideal is equal representation of all founders.

And now, after all your sweat and elbow grease as a SSP manager you can begin to earn your money. After all, what good is all that data if you don't use it to make decisions.

EXOTIC CATS AS TEACHERS: A BOLD APPROACH TO ATTITUDE CHANGE

Cathryn Hilker, Coordinator of Frisch's Educational Program
Education Department - Cincinnati Zoo

As a wildlife conservation teacher, my daily contacts with children from K-12 make me realize that public awareness, at least in this country, concerning conservation issues is growing. This is due in large measure to media impact. TV specials and wildlife magazines find their way into an ever increasing number of homes.

I would like to present to you a brief summary of an approach the Cincinnati Zoo has taken to further heighten and personalize awareness. It is a bold approach to form positive attitudes in young people toward wildlife and the natural world we all share.

Teaching experiences at the Zoo and in schools have shown me that words, nearly unknown 20 years ago, are easily recognized today. Many students and adults can correctly identify the meaning of "endangered" or "habitat loss". Unfortunately, correctly identifying a word does not mean that a person "feels", "believes", or "acts" in any particular way. This is where we confront the attitude change. The Cincinnati Zoo began a program which we felt would cause "feelings" and, ultimately, "actions". We began using a carefully selected few cats who would be ambassadors of goodwill and "attitude formers" to actively speak, in their own behalf, for the cause of conservation. We chose a cheetah, a North American mountain lion, tiger, lynx, serval, clouded leopard, and most important, a domestic cat. The latter serves as a bridge between the world children understand and the wild world of the cat.

It may seem, at first glance, a conflict that a zoo take an endangered animal and use it in an interpretive role, but zoos must keep in mind the important role of interpretation as well as the role of propagator.

As part of the Education Department, this program has employed the skills of a professional animal trainer who taught those of us involved in the program safety precautions and training skills.

Our role as educator with the cats is three-fold:

1. We stage educational talks in the Zoo's amphitheater 4 days a week during the summer months where we illustrate "natural behavior".

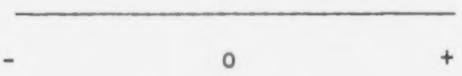
   When we speak about the jumping ability of a cougar, that is exactly what the audience sees.

2. At our specially constructed Zoo facility with a large play yard, we again illustrate natural behavior with our cats running free. This program is called "Close Encounters". Visitors are thrilled by the speed of a cheetah or the free leap of our cougar.

3. Our third phase starts with the school year. Our cats have visited over 100 schools in the last 2 years. We speak to relatively small groups (between 100 and 300), since we want the program to remain as personal as possible. Thus, we complete our year-round educational efforts.

And what is it we are trying to do? As I mentioned earlier, the cats are "attitude formers". It is important to examine what determines a person's attitude. What is attitude?

Attitude is easily demonstrated by showing the picture of a spider to a general audience. There are few people who will not have some reaction--reactions which range from "get that away from me: to "what a neat spider". Identification of the picture as a spider is comparable to an audience knowing the meaning of the word "endangered". The reaction is what is important. What causes the reaction is a person's "attitude". "Attitude" can be illustrated on a continium.



The attitude of the developer who views a swamp as a "shameful waste of good space" to the ardent naturalist who sits on a rocky ledge to count Eagle nests, can be diagramed on this continium - - - negative, neutral to positive.

How a child sees an animal, what he feels about the animal, what he believes and how he reacts, dictates his attitude. Our cats help form positive attitudes by exposing students and adult, probably for the first time in their lives, to an animal which becomes personal to them. Studies have show that early exposure to animals, with interpretation can cause positive attitudes. Our own study indicated that conservative attitudes of students increased after seeing our program. (I shall speak more about our study later.)

Lack of firm wildlife policies and uncontrolled harvest have taken a terrible toll of wild populations. A mistaken belief that there was an endless supply of animals has led to the extinction of many species. Whether through unwise land management or human population growth, habitat loss is now recognized as one of the most serious threats to wildlife. In the U.S., alone, an estimated 3000 acres a day are bulldozed. The earth's tropical rain forests, which contain an estimated 1/2 of all known species of plant and animal life know, are disappearing at a rate of 15 million acres a year. The range of the African cheetah, for example, has been radically altered. Being an animal which depends on sight and speed as hunting techniques, the cheetah needs large open areas in which to hunt. Although never as abundant in its range, as, for example, the lion, cheetahs nevertheless once ranged over most of the African continent. Habitat loss for the cheetah has been dramatic.

N AMERICA
N AMERICA

(Habitat loss becomes personal when students understand the animal it affects.)

And now we face those important questions. What does our Attitude Formation Program do about it? How do we know that we make a difference?

By the Cincinnati Zoo's efforts in bringing their great cats out to the public as educators, we make a personal, visual impact. 155,000 Zoo visitors personally saw these cats just this summer. They heard a cheetah purr and saw a cougar jump. Our school program reached 24,000 students in our first year and 32,000 this past 1984-85 school year.

Do we dare hope that this type of program, competently organized, professionally carried out, could spring up in other zoos, both in the U.S. and in other countries where the issues reach the very people who have the final vote on conserving their wildlife? Advertisers have long understood the importance of attitude formation in promoting a product. The product we must promote is conservation. Zoos are viewed as the ark for preserving endangered species. The endangered species themselves may be the force necessary to get the ark safely ashore. In 1983, Stephen Kellert, associate professor in the School of Forestry and Environmental Studies at Yale University, wrote a paper entitled Children's Attitudes, Knowledge and Behavior Toward Animals. In this paper he stated "very limited knowledge of animals among children who reported learning about animals in schools and visiting zoos was particularly discouraging. Despite the widespread nature of these activities, they appear to have little lasting impact. Most zoological parks continue to fail in attempts to go beyond superficial entertainment to instilling a greater appreciation and knowledge of animals". The Cincinnati Zoo is trying to correct that failure.

One of the criticisms frequently raised about programs involving animal usage is that it promotes the pet image. We confronted this question directly by testing with a preliminary survey we surveyed 778 students in grades 6, 7, and 8. 528 students surveyed saw our program - 250 did not. The students who saw the program were surveyed 3 to 5 months after the program. We tested the groups who did not see the program to discover it exotic cats appeared as potential pets. Forty-seven percent replied that these animals are not potential pets, which means that over 1/2 of the students who did not see our program view exotic cats as potential pets. We did not test to find out where this surprising attitude comes from, but we suspect movies and TV which depict trained animals and offering no interpretation, gives the image. Stuffed toys can probably give this image to youngsters. What thrilled us was to find that in the group which heard our program seventy-seven percent replied that the animals are not potential pets. Our program not only does not cause a pet image, it actually dispells the image already held by children. We have contracted with 4 graduate students from Miami University to do an in-depth study on this subject.

The cats make our talk personal. The children we see have a personal stake in conservation issues we raise because they see the animal - not behind bars, not over a moat, not on a TV screen - but in person.

(Picture Follows)

What are our results? Children who stop me in a super market or on the Zoo grounds and ask, "How are the cats? They came to our school." Children who literally drag parents up the hill to our exercise area and proudly point to our cheetah and say, "That's Angel." Children who have not seen our cats for as long as a year have answered questions I have asked at later talks, showing an extremely high percentage of recall. Three 11-year old boys saw our cats at the exercise yard, went back to their schools and personally organized and raised the money to share their experiences with their friends. That's what it is all about - attitude formation. They have seen, heard and now they care! Children, wildlife, and habitat

(The child who goes home with black grease marks on his face, like the cheetah, is eager to tell his parents it helps cut down sun glare. He becomes an ambassador for the cat he has encountered.)

preservation are tied to one another by education, awareness, caring and finally -- attitude. How today's children "think", "feel" and "act", as tomorrow's adults will determine the future of our wild world.

As Baba Dioum said, "In the end, we will conserve only what we love, we will love only what we understand, we will understand only what we are taught."

They have no voice but ours, and without attitude change, they will have no place to go.

Judy Rand, Editor/writer
Monterey Bay Aquarium

Fish Stories That Hook Readers: Interpretive graphics at the Monterey Bay Aquarium

(Video footage of visitors reading and reacting to the interpretive graphics throughout the aquarium.)

You're watching as our hidden camera records the behavior of a rare subspecies of aquarium visitor, believed by the scientific community to be nearly extinct. These little-known creatures are called...readers. Watch, as we observe them, how unaware they seem their very existence is in dispute.

If we were to leave our blind here behind the octopus tank and move freely among them, we could hear their characteristic calls. "Huh," says a solitary male. "Did you know they were related to octopus?" another male asks his mate. "She may release 380,000 eggs a year. Can you imagine that?" one female asks another. A third one finishes reading a line and laughs. And a mother points: "Look, honey, at those lines on the fishes' sides. It helps them feel things around them in the water."

Hasn't anyone ever told these people that nobody reads the labels?

In the eleven months the Monterey Bay Aquarium has been open, our observation has been that people do indeed read the labels. Unfortunately, the overwhelming attendance has prevented us from conducting a formal evaluation--crowds in summer averaged 8,000 a day: no time to be timing people reading. But what we've seen so far through informal observation and visitor feedback indicates that more people are reading--and, moreover, enjoying reading--the interpretive graphics.

Why this strange behavior? Perhaps the crowds are so thick they can't get up to the tank windows, and so read while they wait their turn. Or perhaps they find the graphics worth reading; a word, a phrase catches the eye, and before they know it, they're... hooked.

I think what we're seeing supports the theory a number of labels experts hold today: that people will read labels--if the labels are written and designed to be read.

In her comprehensive guide to labels, Beverly Serrell tells how to accomplish this...and suggests you sit down with a glass of wine before you begin! Actually, you need fortification long before you sit down to write: you need the cooperation and support of your exhibit development colleagues, usually educators and curators. (Because our team meets in the morning, I substitute cookies for wine--which also help gain support when you're seeking approvals.)

I'd like to share some of the other graphics approaches and methods we use at the aquarium, and take you through our process, from concept...to cookies...to completion.

No matter how the final graphic will look--silkscreened, sandwiched, set in a book or hung from hooks, its content must follow interpretive, editorial and design guidelines determined by the way you want the label to work for the audience. In order to be effective, such guidelines need to be set early in the exhibit planning stages; program developers shape them in answer to the institutional goals and objectives for the exhibit program and interpretive graphics system.

At the aquarium, program development begins with brainstorming sessions. Cookies work to lure the executive director, directors of education and husbandry, and head curator--the "program committee"--into a meeting with the writer. After they agree on the key ideas to be conveyed by the exhibits and graphics, the writer returns with a "prewrite," a series of paragraphs on the main message and important facts that will be communicated in each graphic. (Brainstorming and approvals sessions use up lots of cookies, but they're an invaluable forum for early communication--and agreement--among program development principals.)

After the program committee approves the prewrite, the writer and exhibit designer begin creative collaboration and concept development. The third stage involves writing, design and approvals of the text, art and exhibitry, working within the physical constraints of space available for labeling.

Visitor attention span, label legibility and readability, label readership, learning modes, museum fatigue--these and other topics pertinent to label writing and design must be considered in order to evolve optimal label lengths, line counts, typeface, character sizes, colors and so forth, just as evaluations will enable us to alter those systems--or individual labels--that prove ineffective.

The final stage is production and installation, requiring about 36 complicated fabrication steps and a crew of artists, silkscreeners, carpenters and the like.

Our concept stage began with the standard communication questions: "Who is our audience?" "What do we want to say to them?" and "How should we say it?"

We decided the graphics should reinforce our regional theme, focused on the habitats, communities and marine creatures of Monterey Bay. Our goal was to reach the widest possible audience, hoping to strike a spark in them that would kindle their interest in the marine environment.

Next, we set specific objectives for the labels:

1. Attract the readers' interest and draw them into the subject.

   Squids have orgies, but octopuses have close encounters

   Think of a ray as a flat, gentle shark

   Life is boring in the wharf...
   Borers can eat themselves out of house and home

2. Correct misconceptions the visitor may have.

   What good is a weedy old saltmarsh, anyway?
   Wildlife flocks to Elkhorn Slough

   They may look empty, but mudflats crawl with life

   Think a clam is a clam? Dig deeper

   This plantlike creature is actually an animal

   Cup corals in these cold waters don't build reefs like their tropical kin do.

3. Reach the more advanced reader with more complex concepts rather than more complex language.

   Why don't fish sink?

   Are you watching a rockfish that's hovering? Floating close to a crevice? Just resting? Wherever your fish is, it's using a buoyancy regulating organ called a swimbladder to stay in place.

   To rest, a fish must be as dense as water. More dense, and it sinks; less dense, and it goes up and away. A gas-filled swimbladder makes the heavy fish lighter. As the fish swims up or down, it controls the amount of gas in the sac so it can hover at any level.

4. Do more than tell the facts; ask questions.

Which jaws could crush a crab?

Can you find the flatfishes?

5. Present problems.

Not all fishes need a buoyancy regulator; when a wolf-eel or sculpin swims, it doesn't go too far from the bottom. But what do you suppose happens when a wolf-eel stops swimming?

6. Express a sense of the unknown in marine science, acknowledging unanswered questions about the oceans.

Another mystery of the deep: If red fishes look black (at depths where red light is filtered out) why are they red in the first place? We don't know.

7. Draw analogies.

Flatfishes are quick-change artists

Like vultures, scavenging hagfish keep order on the floor

Orcas are the wolves of the sea

8. Use a reader-relevant approach to explain things.

Orca clans take care of their own

Reach out and touch and taste someone

An octopus explores with its tentacles. The suckers can taste the difference between sweet, sour and bitter, and can tell if something's rough or smooth.

9. Write in easily understandable language aimed at the 7th-8th grade reading level.

Why do these rocks look alive?

Sculpins and other bottom-living fishes

often look like the rocks they rest on. This camouflage works--as long as they sit still. If you look closely, you'll notice some have triangular bodies. That stable shape helps the fishes maintain their rock act.

10. Communicate in a conversational tone that is approachable, familiar, often humorous, but not flippant or formal.

See the rock with ruffles?
That's the hornmouth, one of
our more ornamental snails.

11. Maintain a style characterized by active voice and vivid language.

Dune plants fight for a foothold in shifting sands

Sea stars use suction to pry open their prey

Pulling on a shell for hours with its small hydraulic tubefeet, a sea star will exhaust even the most clammed-up clam.

12. Address the reader directly.

Watch as these small silvery fish pass in a school, and you'll catch some 'yawning.'

The tentacles you see are sensitive to touch, and help locate drifting algae.

Odds are you won't find this cleverly-camouflaged fish. Try looking for a blade of kelp that has two round eyes.

13. Anticipate and answer questions.

What's out there under all that water?

Why do otters scratch so much?

Otters aren't scratching because they itch; they're grooming. This keeps their fur clean and waterproof.

14. Be concise, friendly, highly interesting, inviting the audience to read and keep reading.

> Rays turn shark fins into wings
>
> A ray's pectoral fins are big, broad wings joined to the head. Instead of swimming fish-style, tail flexing from side-to-side, a bat ray swims by flapping its wings.
>
> Wings also work to dig up dinner. By beating them on the seabed, a bat ray unearths worms and clams.

As you can see, initial objectives become valuable guidelines to check your message against--as it goes through all the dizzying stages of research, prewriting, writing, review, cookies, approvals, editing, more review, cookies and approvals, design, mock-ups, prototypes, review, cookies, approvals, art, review, more cookies, approvals, production, cookies and installation.

Our primary goals for the finished graphics were attractiveness, legibility and readability. We designed the labels for two kinds of reading: quick skimming and thorough reading. Quick skimmers should be able to scan the label's head and subheads and get the main idea we want to communicate. More thorough readers--who may read the panel line by line, or first skim the heads, look at pictures, then return to read--will digest the material.

The amount of text on a graphic depends on its interpretive function, but is also governed by such factors as available wall space. To encourage reading, we keep graphics brief. This requires extremely careful editing to fit the limited space.

IDs are our shortest interpretive graphics; they identify a species, offering basic facts (diet, size) and a brief sentence or two. Aquariums usually subject visitors to a bank of backlit IDs, which people scan but seldom read. (If each ID in a lightbox ten IDs long is ten or more lines long, can we blame them?)

We try to communicate one idea well in one or two sentences. We point out interesting adaptations the viewer can observe, and behaviors he or she may witness: feeding, breeding, schooling, etc. Other effective topics include developmental changes, coloration, locomotion, unusual physiological or morphological adaptations, defense strategies and commercial value or interaction with humans.

Because of our regional status, we look for "the local angle," constantly placing the species in its context within Monterey Bay. Besides focusing on habitat, distribution, seasonal occurrence, and so on, we discuss results from local studies or current research.

A consistent layout on IDs--image above, text below, or image left, text right--makes it easier for skimmers to get the information they need and encourages readers by minimizing the distractions inherent in "busy" design. Some of our IDs don't have text at all--just an image and a name.

Longer graphics require careful editing, too. But unlike IDs, their layout can vary to heighten readability, so long as they incorporate consistent features (titles, photo sizes) to preserve continuity. We communicate with readers at several levels by writing our text in manageable paragraphs--4-5 lines at 50-60 characters per line. Each paragraph has a subhead that summarizes meaning as it catches the reader's attention. Some readers proceed to read the entire panel. Others read only the headlines, and perhaps a line or two of text, just as they skim a newspaper. Still others attend only to the illustrations or photographs, and read no further than the captions.

A general panel includes two to three paragraphs, and sometimes photo captions. The paragraph is a unit of thought. Each has its own subhead. This lets the nonreader skim the subheads for the main idea, and draws the casual reader or skimmer into reading a paragraph whose head caught his or her eye.

A focus panel has one to two short paragraphs, and may include a photo caption. It "focuses" on a particular species or group. We use focus panels to give readers more in-depth information about the species on display wherever space permits, and where there are only one or two prominent species to the tank. Instead of stringing together unrelated ideas, a focus panel should amplify and clarify the main message telegraphed by the subhead.

Besides varied attention spans and reading levels, the public has differing degrees of myopia. We chose our typeface, Optima, over the highly legible Helvetica because it was "personable" as well as readable. Type size, line length and spacing were determined by the distance between viewer and graphic.

I'd like to wrap up with some specific techniques on how we do our "fish stories": techniques for translating and transmitting your message to the general public, to help you make your labels more inviting, more involving--and more often read.

Find your voice, then keep a steady tone.

Maybe you want to communicate with your audience by telling stories, or perhaps you'd rather evoke a sense of grandeur and mystery...shake their complacency...or be as friendly as possible.

We aim for the latter, and so use informal conversational English, marked by active voice, a sense of humor and familiar, idiomatic expressions. Once you've found a "voice"--consistent, well-executed tone and style--for your aquarium or zoo, have your approvals group agree on it, then keep to it. This doesn't rule out variety! Our friendly, involving, conversational tone encompasses puns about boring clams (bivalves that drill into shale) and objective discussion of the sea otter's threatened status.

Make every word count.

Borrow devices from the masters of condensation: poets, journalists and ad writers. Each faces the same task we do: to grab and hold the reader long enough to transmit a message. Use a hook--describe with active, lively, direct language, then reel your reader in.

Watch your language!

Remember "museum fatigue," and how tiring it is to read on your feet. Involving graphics are brief, addressed directly to the reader. Use language that's at a 6th-7th grade reading level and text relevant to the topic and relevant to the reader's experience. Besides keeping difficult words till the end, to avoid losing readers, try coupling the technical terms you do want to teach with their synonyms.

Enjoy English as much as science.

Use catch phrases where you can, or play with idioms; relate them to the reader. Paint a complete picture: be vivid. When you describe an action or cycle, relate it consecutively, to enable the reader to better visualize it. Make connections; let the readers make some for themselves. Impart the feeling you have, your excitement and wonder about the topic. Invite the readers in: describe the sights for them, name the characters, interpret the action--and they'll be able to share the mystery.

Show your style.

The most striking feature about our graphics--the "hook" with which we try to catch readers--is wordplay. Literary devices like alliteration, onomatopoeia, metaphor, simile, even puns, are just as effective in labels as they are in any piece of good writing.

Talk straight.

We use the second person ("you") as well as first person plural ("we") to directly address the reader. Words that "point" ("this fish," "that rock") make the communication immediate; words that encourage readers to look or act ("See that pink crust on the rocks?" "Can you find the flatfishes?") make the communication involving.

Surprise!

Don't be afraid to use words you've never seen in labels before--if they're concrete and effective. Use attention-getting words in the beginning to hook a reader--or at the end, as a treat. Some that have worked for us: "Slurps." (That's how a pipefish feeds.) "Zaps." (That's how an anemone stings intruders.) And, oh yes, "sex." (That's what keeps biologists in business.)

There will always be skeptics who shrug: "Why bother? Nobody reads the labels anyway." It's time to tell them that readers are not a rare breed. Let us do the labels right, and people will read. We need to make the point again that labels poorly done will not be read, and labels done well--written and designed to be read, will be read...and enjoyed.

Then you too will be able to spy on your visitors, hidden camera or no, and listen to them saying "Huh!" and "Did you read this!" and "380,000 eggs in a year--can you imagine?"

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SENSE-SATIONAL MARINE EDUCATION

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INTRODUCTION

The ocean environment and its creature inhabitants can alert the senses to learning in new and exciting ways. Sea Life Park is located at Makapu'u Point on the main island of 'Oahu in Hawai'i. Here, the Koolau Mountain range, formed over 2-1/2 million years ago by volcanic eruptions, meets the rocky tidepools, coral reefs and warm Pacific waters filled with marine life. This natural setting alone provides a stimulus to seek new adventures.

The Sea Life Park Education Department was formally established in December 1978. Today, almost seven years later, we are pleased to offer a wide selection of programs for not only our visiting school children but also for our general public, ranging from pre-school to retired ages.

A major goal of the Education Department has been to provide the schools and community as well as Hawai'i's visitors with the opportunities to develop awareness of ecological and conservation issues and to gain knowledge, skills and first-hand experiences in the field of marine and related sciences. Sea Life Park is a unique learning facility where animals and plants can be observed and studied in habitats as close to natural as possible.

INTERPRETATION THROUGH THE FIVE SENSES

Interpretation through the use of the five senses--seeing a dolphin close-up, the internal anatomy of a fish; hearing, a special lecture on our Hawaiian Reef Tank inhabitants, a story about fish, the sounds of seabirds; smelling, a seabird feather, a piece of shark skin; tasting, steamed poi and luau leaf, kamoboku, which is steamed fish cake; and feeling, a pin cushion sea star, a squishy sea cucumber, a Green Sea Turtle skull. These senses provide a key to reaching students of all ages.

By providing teachers, recreation specialists, community resource persons and other educators with an enrichment program offering the extensive use of educational props, students' interest in the marine sciences is readily stimulated.

DEVELOPMENT OF TWO CORE PROGRAMS

Two core programs were developed to begin the park's formal educational offerings...the popular Sense-sational Marine Education Program for grades 4, 5 and 6, and the Volunteer Docent Program for high school seniors and adults. For the preparation of materials for the implementation of the two core programs, a small group of people were recruited. The park staff, a few dedicated resource people and three high school students, who were very interested and willing to do most any job from cleaning and preparing props to spending hours at the copy machine, assisted the education staff of one. We were small in numbers, but a diligent group of people.

It was a pleasure to discover that people were more than willing to spend time, energy, hidden props, resources and expertise towards the Education Department's beginnings. Our park staff and resource people devoted hours in digging up and assisting in the preparation of useable specimens and equipment, sound recordings, photographs, charts and illustrations. As a result of these efforts, a very special group of people became a part of the Sea Life Park staff--the volunteers.

VOLUNTEER DOCENT PROGRAM

In February of 1979, we offered Sea Life Park's first Volunteer Docent Training and Instructional Workshop. This six week, intensive, high school and college approved credit course meets on Mondays, Wednesdays and Fridays from 9 a.m. to 12 noon in the Sea Life Park education classroom.

Thirteen sessions focus on topics such as dolphins, whales, sea lions and seals, reef fish, invertebrates, seabirds, plants and aquaculture. Information is given through lectures, slide presentations, demonstrations, observations of live animals and off-site field trips. Speakers include marine experts from the park staff, university and government agencies. Four teaching methods, practice and evaluation sessions culminate the workshop.

Though it was a skeletal crew of eight volunteer docents who operated the Spring 1979 Sense-sational Marine Education Program, they were a dedicated group whose interest and energies were high. Their personal schedules were made flexible to ensure that the program would be provided to our visiting school and education groups.

The volunteer docent staff now averages 40 people a year. We hope our numbers will increase so that more programs can be offered in the future. An impressive number of 164 volunteer docents have worked for the Sea Life Park education department since 1979. This number is large for the island of 'Oahu when you consider over twenty other organizations operate their education programs with volunteer docents as well. They have come from as close as Waimanalo, our own rural town and as far as Hale'iwa, an hour and a half away on the opposite end of our island. We even have docents from Canada who return each school year to serve our students. Some are high school and college students who may receive credit; others are career and family people and retirees. As a special note--I am pleased to mention, to this date, 35 volunteers have worked, or are currently working, as employees of Sea Life Park.

Special lectures and monthly field trips enhance the volunteers' experience. Field trips are offered to develop new knowledge, appreciation and understanding of different environments, animals, plants and programs. Some sites visited are: lava rock tidepools where seaweed pressings are made on-site; the nearby Red-footed Booby colony to observe and photograph the chicks and their parents; the Blue Water Marine Lab Program to experience other teaching techniques and gain new skills and knowledge, such as navigation on-board a sailing vessel; Waimea Falls Park where discoveries are made about the shampoo ginger plant and shark gods; and the Mokauea fish pond project operated by the University of Hawai'i's Marine Option Program.

Social events, discounts at park shops and in the community and annual family passes are among other benefits of being an active park docent. Social events such as: our annual Christmas luncheon, complete with a Hawaiian Santa, and special gifts specially suited for each volunteer, Humpback Whale watching get-togethers where Humpbacks can be seen right from our own education building and End of Summer/Beginning of School Year bash are enthusiastically attended. During these times we take the opportunity to honor special volunteers with recognition awards. During National Volunteer Week, our volunteers were honored by a visit from our First Lady, Mrs. Ariyoshi.

Although our volunteers receive all these "extra" benefits, for most of the volunteers, the real reward is personal enrichment--the opportunity to share with others their special interest, enthusiasm, knowledge and concern of Hawai'i's ocean environment.

SENSE SATIONAL MARINE EDUCATION PROGRAM

Twelve different marine and related learning stations operate each week during the school year for 4th-6th grade students and teachers. Teachers have used the program as an introduction to, enrichment for and/or a climax to a marine studies unit handled in their classrooms.

Environments created for the animals have been kept as natural as possible so that both animals and people have the benefits of "true to life" environments. An excellent exhibit for the observation of social and natural behaviors of animals is at our sea lion facility. It is a successful breeding colony which annually produces sea lion pups. Our staff was very pleased when a rare birth of twins occurred for one of our sea lion moms. This May, we were surprised with the birth of a hybrid--half Atlantic Bottlenose Dolphin and half False Killer Whale. The affectionately-named "Wholphin" is doing fine in our Training Area. By providing on-site, educational and fun experiences for the public, Sea Life Park has become a dynamic learning facility in Hawai'i.

Students arrive at the park prior to regular visitor hours and attend the docent-operated learning stations. During each 25-minute period of time, live animals can be observed at the conclusion of the sensory-aided learning station.

What better way to learn than from the animal itself? At the Sea Birds of Hawai'i learning station, Mokapu, a soon-to-be adult, Red-footed Booby bird, allows students to discover his changing colors, methods of thermoregulation, soft plumage, eating and preening habits, the distinct smell of a bird and of course, his big, red, webbed feet. Below the 5/8-scale model of our whaling ship, Essex, False Killer whales and Bottlenose dolphins provide "real" communication sounds in addition to the taped recordings of different cetaceans. Often, students have several whales and dolphins peering through the portholes during the Whales Learning Station. Even though a whale petting pool is not available students learn about the skin texture of these mammals by touching the " Feels Like a Whale" sensory aid. The whale prop is made of cut out rubber inner tube and attached to the inside of a plastic bucket filled with water. "Eew!...limu! What is it?" "Something yummy for both people and many invertebrates. It's seaweed! Try some!" At the Invertebrates of the Sea Learning Station, students and teachers have the opportunity to discover the fascinating environment which surrounds the islands of Hawai'i. Through knowledge, respect and understanding of the animals and their unique habitats, students and teachers are stimulated to don their reef walking shoes and begin to eagerly explore the tidepools.

Today, we are proud to offer a variety of school programs. In addition to the 4th, 5th and 6th grade Sense-sational Marine Education Program, we present "Legends of the Sea", for grades 1, 2 and 3. The program provides a 20-minute factual and sensory-aided learning station and a short 25-minute play focusing on the featured marine animal--the Green Sea Turtle, in this case. "Aquaculture: Yesterday, Today and Tomorrow" is offered to high school students and older. Ancient Hawaiian fishponds are discussed along with the modern and future aspects of the aquaculture industry. A new pilot program for pre-school and kindergarten students had been tested and well-received in the 1984-85 school year. Aside from regularly scheduled and grade level programs, many special presentations are given for all ages, including special education and physically and/or mentally impaired groups.

PUBLIC EDUCATION PROGRAM

Public education program development has grown for Sea Life Park in the last several years. In November 1983 the education staff developed and coordinated, with the assistance of the entire park staff, a 40-minute behind-the-scenes guided tour for our visiting public. This was in addition to the already successful Pacific Whaling Museum lecture which was added along with the Sea Turtle, Seabird and Sea Lion and Seal lectures to the park's regular shows and exhibits in 1980. The personalized walking tour provides information and a "hands-on" approach to learning for visitors as they are guided through the park to the invertebrate holding tank, our 300,000 gallon Reef Tank, Sea Lion and Seal pools and Bateson's Bay training tanks. How do you train a dolphin? Have you tried playing volleyball with dolphins?

COMMUNITY CLASSES

Class, classes and more classes! We are continually expanding our offerings for our local residents and return visitors--offering one class in 1979 and 38 in 1985! Pre-schooler and adult teams join us in fun, facts and crafts in Keiki & Adult Explorations; elementary and intermediate students tidepool and discover interesting animals and plants along the seashore; Marine Animals on Film is adaptable for ages 7 through adult--participants learn the art of videotaping and study a marine animal of their choice; the training staff provides a special lecture series on marine mammals, seabirds, and the care, feeding and training of these animals. Other classes offered throughout the year are Marine Animals and Plant Photography taught by our park's photographer, Sea Creatures and Crafts, Tidepool Trek and Makai to Mauka, from the sea to the mountains.

CONCLUSION

Our efforts to continuously improve existing Sea Life Park education programs and develop new enrichment experiences for people of all ages are constant. With the addition of new programs, an increase in education personnel was necessary. We are pleased to have an energetic and creative education staff of seven employees, five who are full time and two, part-time, and, of course, a dedicated support group of 70 trained docent and general volunteers annually who provide us with the working force to implement our programs.

In conclusion, by interpretation of subject matter through the senses, experience has shown that if a person "tunes out" during one sensory experience, it is more likely than not, that the person's interest will be reactivated through a new and perhaps different sensory experience. Therefore, with the use of a variety of sensory aids, an assurance of new knowledge will be imparted, and retained by each individual during each presentation. At Sea Life Park, we are convinced that sensory-packed programs are successful.

ZOO VISITORS: CAN WE MAKE THEM BEHAVE?

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INTRODUCTION

Zoos have become increasingly concerned with the behavior of their visitors. From the perspective of zoo personnel, it is desirable to control visitor behavior in several ways: (1) to influence visitors to return to the zoo as many times as possible; (2) to inculcate visitors with educational information and attitudes such as conservation-of-wildlife; and (3) to direct visitors to engage in appropriate visitor behaviors (e.g., being courteous to other visitors, following directional signs and arrows) and refraining from inappropriate behaviors (e.g., feeding animals, teasing animals, littering, damaging property). The present study provided data on some of the factors that appear to influence visitor behavior at zoos.

A simple model of visitor behavior was formulated. This model assumes that visitor behavior is primarily controlled by three factors: (1) the attractiveness of the exhibit; (2) the physical and psychological comfort of the visitor; and (3) the types of controlling stimuli directed at the visitor.

Attractiveness of Exhibit

It has been quite obvious to zoo personnel that visitors will be drawn to and remain longer at exhibits that are more attractive. The question is: "What makes an exhibit attractive to visitors?" One of the most frequently documented variables is animal activity (e.g., Hodges, 1978; Martin & O'Reilly, 1982). An active animal appears to be more interesting or entertaining than an inactive one. Although animal activity has been shown to influence visitor behavior, to our knowledge, no one has systematically looked at other variables that make an exhibit attractive. Other variables such as animal size, animal beauty, artistic and dramatic characteristics of exhibits, and proximity of animal to visitor may all play a role in the visitor's perception of exhibit attractivenss.

Visitor Comfort

A second factor related to the control of visitor behavior is visitor comfort. This factor is likely to be an important factor with zoo visitors or with people in any environment. Temperature, crowding, smell, lighting, and noise are all likely to affect the behavior of visitors. Common sense tells us that people are less likely to go outside on a rainy day. Although visitor comfort is an obvious factor, it has not been systematically studied in zoos. Under what conditions will visitor comfort play a more or less important role? Under what conditions will a visitor avoid viewing an otherwise attractive exhibit because of factors such as crowding, heat, or smell? Will visitors stay in the zoo longer if comfortable seating is provided?

Controlling Visual Stimuli

There are at least three types of stimuli used to control visitors. The first type exerts directional control (e.g., entrance-exit signs; traffic-flow arrows; orientation maps). The second type provides information about the exhibit (e.g., labelling signs and guide books). The last type of stimuli is an instruction-to-action cue (e.g., "Parents, ask your child to identify this animal", or "Don't feed the animals"). Several articles have been concerned with one aspect of directional control: orientation devices such as maps, information desks, and signboards (Cohen, Winkel, Olsen, & Wheeler, 1977; Levin, 1982; Sharpe, 1983). As an example, Cohen et al (1977) found that visitors to the National Museum of History became less disoriented when maps and signs were introduced into the Museum.

The other types of controlling stimuli have been less frequently studied. Only one experimental study could be found that looked at sign-labelling, the most common type of information stimuli. Hodges (1978) found that the letter size and the amount of text on a sign affected visitor viewing time. Viewing time increased dramatically when the letter size was increased and the amount of text decreased. No studies could be found that evaluated the instruction-to-action stimuli.

METHOD

Visitor Viewing Time

Observers recorded the visitor viewing time in six areas of the Birmingham Zoo. These areas were: (1) the Predator House; (2) the Bear Area; (3) The Monkey Area (outside cages); (4) the Pachyderm Building; (5) the Reptile Building; and (6) the Hoofed Animal Area. Three exhibits from each of these areas were selected for measurement of visitor behavior. In the Predator House, the exhibits were: the Spotted Leopard, the Cougar, and the River Otter. In the Bear Area, the exhibits were: the Grizzly Bear, the Polar Bear, and the Asiatic Bear. In the Monkey Area the exhibits were: the Gibbon, the Guennon, and the Lemur. In the Pachyderm Building, the exhibits were: the Hippopotamus, the Elephant, and the Rhinoceros. In the Reptile Building, the exhibits were: the Reticulated Python, the Indian Cobra, and the Boa Constrictor. Finally, the Hoofed Animal exhibits included: the Tapir, the Greater Kudu, and the Dromedary Camel.

The recording procedure involved marking off the primary viewing area for each exhibit and measuring the amount of time that individual visitors stopped to observe the animal exhibit. The primary viewing area was determined by visually inspecting the area in which visitors ordinarily observed the exhibit. Only one visitor was tracked per observation. At the beginning of the recording period, the recorder selected the first visitor entering the primary observation area and tracked this individual until he/she left the area. A stop watch was used to time the total duration that the visitor stopped and was visually oriented to the exhibit. Only time stopped was recorded since observation areas differed in size and total time in observation areas as a measure would have been biased by the size of the observation area. If the visitor did not stop to observe the exhibit, then a duration of zero was entered. Ten visitors were chosen for observation during each observation period. Visitors were selected such that one-half were adults and one-half were children. In addition to visitor viewing time, the recorder indicated whether or not the animal was active during the time the visitor was observing the exhibit. Other relevant information was also recorded such as time of day, temperature, weather conditions, and crowd conditions. The size of the viewing area was measured for each exhibit and approximate weights of animals were obtained from encyclopedias and other sources. Animal activity, size of viewing area, and animal size were later correlated with visitor viewing time. Recordings were taken on the following dates of 1985: 11 March; 14 March; 14 April; 2 May; 19 May; 1 June; 7 June; and 15 June. A total of 30 visitors were observed for each exhibit on each day of recording.

Perceived Characteristics of Animals

Animals involved in this study were independently rated by 65 undergraduate and graduate students at Jacksonville State University to determine the perceived beauty, threat, and novelty of each animal. These results were then correlated with visitor viewing time to determine if perceived animal characteristics played a role in exhibit attractiveness.

One-Way Direction Manipulation

After four days of measuring visitor behavior in the Reptile House, the traffic flow was changed from two-way to one-way. The purpose of this manipulation was to see if the decrease in traffic congestion produced longer exhibit viewing times. It is assumed that traffic congestions is an unpleasant state for visitors and this unpleasantness is likely to reduce the viewing times of visitors.

Visitor Response to Signs

Visitors' responses to the three types of zoo signs were measured: (1) Entrance-Exit signs; (2) Exhibit labels and information signs; (3) instructions-to-act signs ("Parents, ask your child ...."). Observers recorded the number of visitors entering and leaving the Reptile and Predator Houses at both the entrances and exits of these buildings which were clearly marked by signs on the doors. In addition, throughout the study, observers recorded whether or not visitors read signs while they were viewing exhibits. Finally, 492 parents were observed at three exhibits with signs that attempted to prompt parents to ask their children a question about the animal.

RESULTS AND DISCUSSION

Overall Visitor Viewing Time

Figure 1 is a graph of the visitor viewing time for each of the 18 exhibits in the study. The Pachyderm and Bear exhibits were viewed longest, while the Reptiles and Hoofed Animals tended to be viewed the shortest amount of time. These results cannot be explained simply in terms of animal popularity since big cats and monkeys tend to be most popular. The following analysis suggests the involvement of several variables that are associated with viewing time.

Factors Related to Exhibit Attractiveness

1. Activity

Table 1 contrasts viewing time between active and inactive periods of animal activity. For each animal exhibit under study, viewing time was considerably greater during active periods than during inactive periods.

2. Animal Size/Viewing Area

Viewing times were correlated with the weights of animals ($r= 0.65$) and the size of the viewing area ($r= 0.62$). It is difficult to determine the relative importance of these variables since they are confounded in the present study. That is, larger animals tend to have larger exhibit areas and consequently larger viewing areas.

3. Presence of Young Animal

The presence of a young animal appears to increase the attractiveness of an exhibit quite markedly. During the first three days we recorded visitor behavior at the Birmingham Zoo, a young Hippo was exhibited with its mother. This young animal was sold while we were continuing to record visitor behavior. The mean viewing time when the young animal was present was 84.2 sec (based on 90 observations). After the young animal was removed, the viewing time dropped to 43.2 sec (based on 60 observations). Similar effects have been observed for other exhibits and in other zoos, although careful measurements have not been taken.

4. Perceived Animal Characteristics

Figure 2 shows the relation between perceived attractiveness and viewing time. The reptiles and hoofed animals tend to be perceived as less attractive and viewed for shorter times than other animals. Although the pachyderms may be perceived as unattractive, their size and activity may be responsible for their longer viewing times. Big cats, bears, and monkeys are perceived as most attractive and viewing times of these animals may be dependent mostly on the activity of the animal.

5. Visual Barriers

The exhibits observed in the present study had three kinds of barriers: bars/fence; glass; and a moat. Bars/fence gives the poorest view of the exhibit, a moat gives the best. When the viewing times are averaged across the type of barrier, the moat barrier average is 51.6 sec; the glass barrier average is 27.1 sec; and the bars/fence barrier is 25.2 sec.

6. Visual Satiation

Viewing times were compared over successive similar-species exhibits and it was found that viewing times were longer for initial exhibits than for subsequent ones. In addition to direct observation, the order of viewing snakes was experimentally manipulated by directing visitor traffic flow in different directions on different days. The animal viewed first was always viewed longer than the one viewed last. This finding will be reported in more detail in another presentation (Bitgood, England, Lewis, Benefield, Patterson, & Landers, 1985).

Factors related to Visitor Comfort

The result of changing traffic flow direction in the Reptile House may suggest that crowding (or congested traffic flow) is an important variable in visitor behavior. The average viewing duration of exhibits was 16.6 sec with a two-way traffic flow. When the exhibit house was changed to one-way, the viewing time increased to an average of 26.7 sec. This increased viewing time occurred despite the fact that the temperature of the Reptile House remained uncomfortably hot throughout most of the study.

Effects of Controlling Visual Stimuli

1. Directional Control

Entrance and Exit signs exert surprising control over visitor behavior. In the Reptile House over 1500 observations were made on visitors' behavior. Over 99 percent of visitors obeyed the signs. A similar result was observed in the Predator House.

2. Information Control

The most important questions with this type of control are: (1) do visitors read the signs/labels; and (2) what do they learn from these sources of information? Throughout all of the exhibits studied, sign-reading behavior occurred from 5.6 percent to 34.9 percent of the time. The highest percentage of sign-reading occurred in exhibits that had a sign with a red background and large letters that read, "This is not a ...... pig, rabbit, ostrich".

3. Instruction-to-Action Control

The Birmingham Zoo has several signs that attempt to prompt parents to ask their child a question about an animal in one of the exhibits. For example, the sign for the Greater Kudu instructs parents to ask their child, "What distinctive features can you see in the Kudu?" Over 500 families were observed and not one parent was observed to ask one of these questions to their children. In their present form, these signs are ineffective.

DISCUSSION

The results of the study support the proposed three-factor model of visitor behavior. In particular, some of the parameters of the three factors were explored. It seems reasonable to conclude, based on the results, that exhibit attractiveness is facilitated by: (1) animal activity; (2) animal size; (3) presence of young/infant animals; and (4) minimal or no visual barriers (e.g., bars, fences). The relative weighting of these factors and the identification of other important variables are yet to be studied.

One of the possible factors in visitor comfort was also studied: traffic congestion in an exhibit building. When traffic congestion was reduced in the Reptile House by making traffic flow one way, viewing durations increased. Another factor affecting visitor comfort is the weather. Every zoo has documented the effects of bad weather on gate attendance. For example, at the Birmingham Zoo during the Spring Vacation for Alabama's schools, there was 25 percent lower visitor attendance on a weekday in which a rain shower occured compared with a weekday in which the entire day was warm and sunny. Variables such as temperature, noise, and smell have yet to be systematically studied.

Finally, the effects of several controlling visual stimuli were assessed in the present study. Some of these stimuli influenced visitor behavior to a much greater degree than others. For example, directional control stimuli (Entrance and Exit signs) exerted considerably more control than did stimuli that attempted to influence by giving information or instructions-to-action commands.

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FOOTNOTES

1. This study was partially funded by the Alabama Zoological Society.

2. We would like to express our appreciation to Richard Mills, Assistant Director of the Birmingham Zoo, and to Jack Bradford of the Alabama Zoological Society for their helpful assistance during the course of this study.

3. Authors' address is: Psychology Institute, Jacksonville State University, Jacksonville, Alabama 36265

Figure 1

Viewing Times for Exhibits in Study

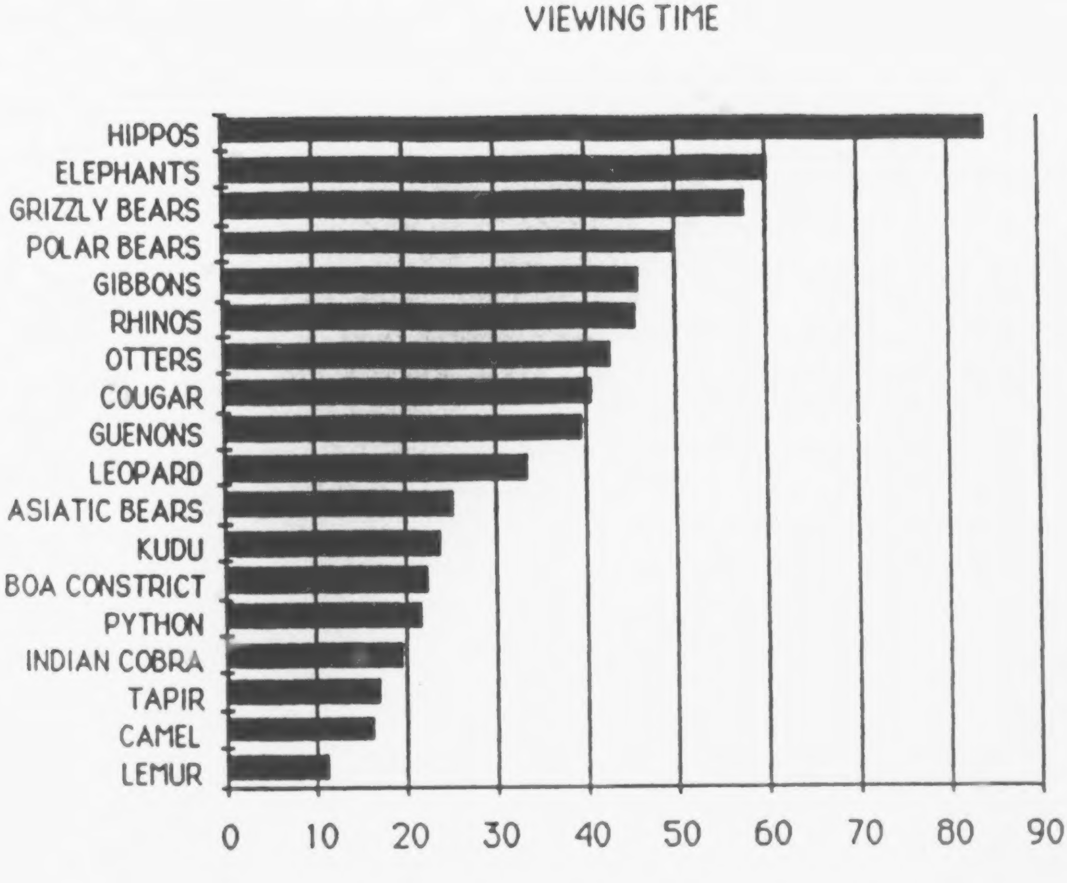


Table 1

Comparison of Viewing Times during Active and Inactive Periods

COMPARISON OF VIEWING TIMES
ACTIVE VS. NOT ACTIVE

ANIMAL	ACTIVE		NOT ACTIVE	
	VVT	% ACTIVE	VVT	% ACTIVE
OTTER	59.5	80	24.5	0
POLAR BEARS	62.3	100	32.6	30
ASIATIC BEARS	40.9	100	10.9	0
GUENNON	48.0	60	15.3	20

Figure 2

Scattergram of Perceived Attractiveness and Viewing Time

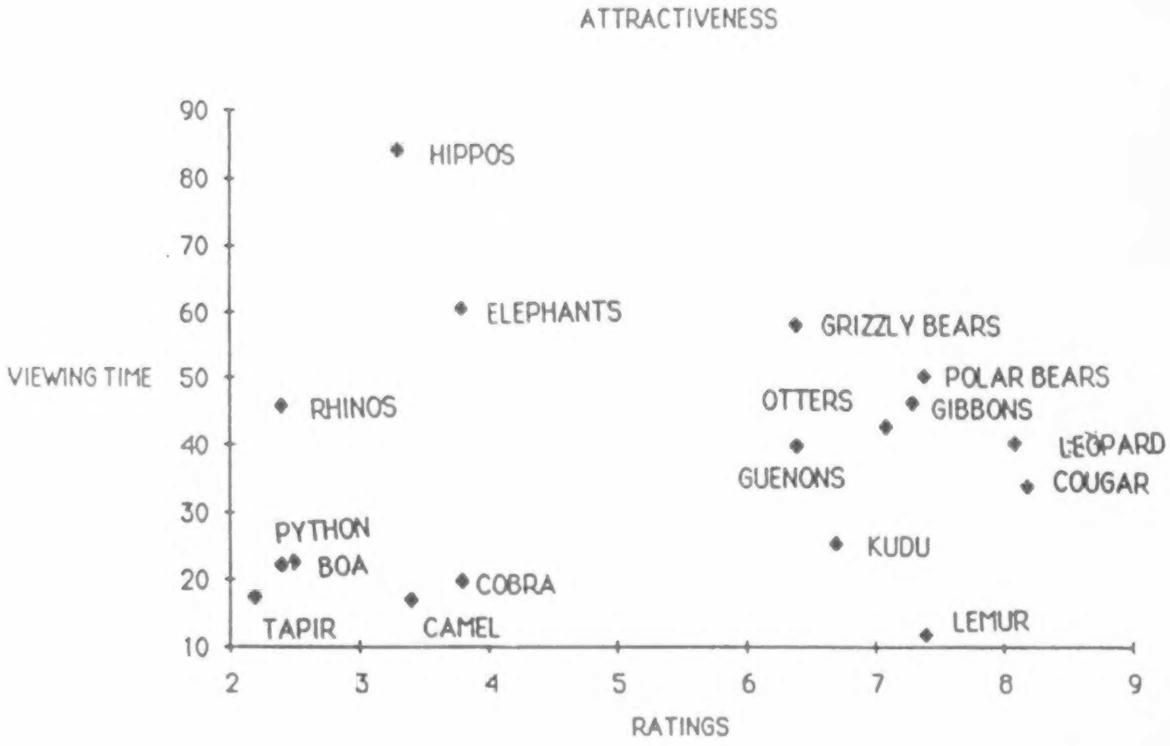


Figure 3

Mean Viewing Times for Three Types of Visual Barriers

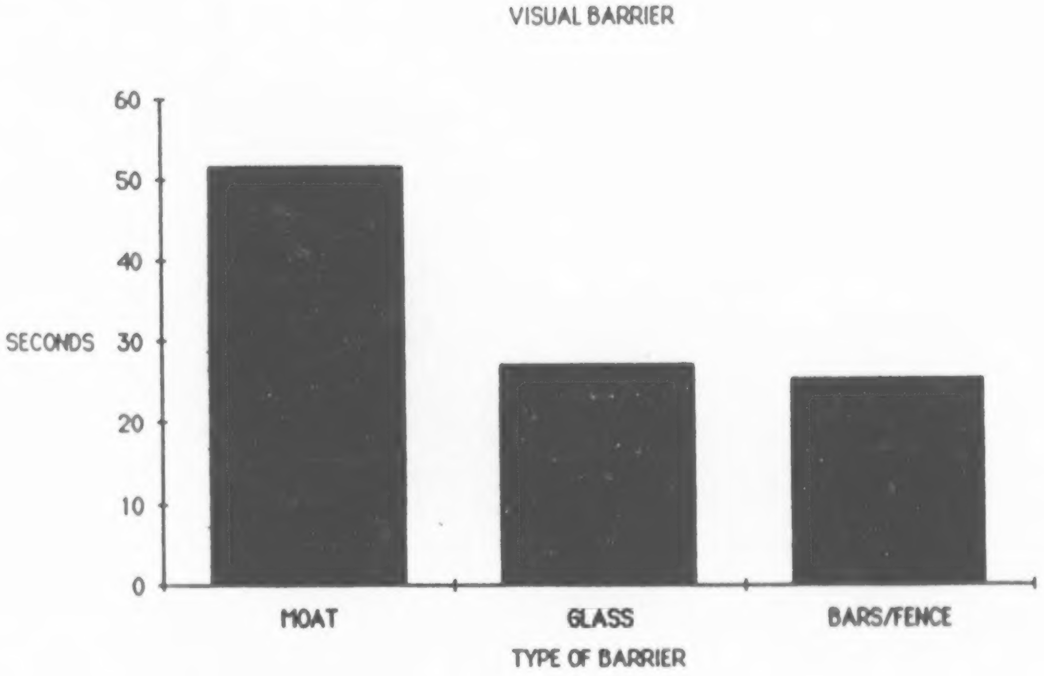
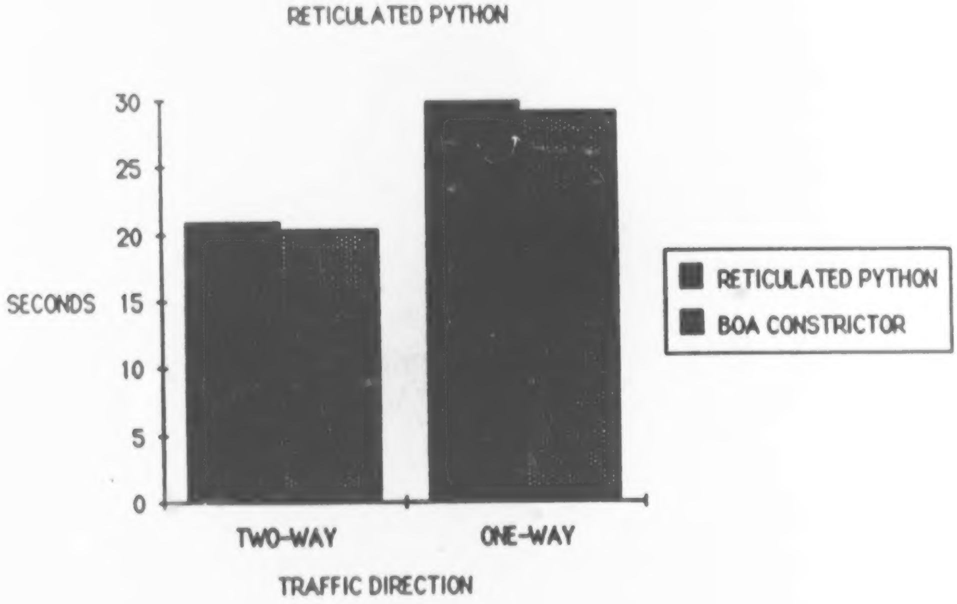


Figure 4

Comparison of Viewing Times for Two- and One-Way Traffic Flow



INSECT DISPLAYS AND REARING AT THE CINCINNATI ZOO
WITH SPECIAL REFERENCE TO THE HERCULES BEETLE

Milan K. Busching
Head Entomologist and Curator of Invertebrates
Cincinnati Zoo

Live insects on display is one of many unique features of the Cincinnati Zoo. The Insect World exhibit opened to the public in 1978 and was the first exhibit of its scope and magnitude in North America to be specifically designed and built "from the ground up" to display living arthropods. It won the National Exhibit Award for the year 1979 by being judged the best display to open at any zoological park or aquarium in the United States and Canada. It was designed to be an educational exhibit that would appeal to a diverse audience of all ages and educational backgrounds. The display introduces people to the world of insects and is seen by about one million visitors each year. This includes about 130,000 students from grade schools, high schools, and colleges who come with their instructors on organized tours to learn about insects.

In addition to the people who see the exhibit in person, millions of others are reached through the media systems. The Insect World has contributed to dozens of newspaper articles, radio, and television segments both locally and nationally.

The visitors are directed through the exhibit along a sequential path dealing with such topics as insect morphology, evolution, numbers and mass, relations with plants and other animals (including humans), defense and escape, senses, locomotion, reproduction, and social behavior. The theme of the Insect World is diversity with the living displays extensively supplemented by graphics, photographs, models, and preserved specimens which ensures the representation of most of the major groups of insects. The combination of both museum and zoological garden techniques results in a unique and attractive presentation.

Insect identification railings or "pinning rails" are located in front of the display walls and contain appropriate pinned specimens, text, paintings, and line drawings. The specimens and labels can be easily changed thus insuring flexibility and interchangability between the displays. This format makes it possible to immediately place on display newly acquired species.

In designing the Insect World it was felt that captive insects would be best displayed in a naturalistic context, with the primary focus placed on how they live in their world. The introduction of living plants and other animals into the displays serves to underscore the enormous importance of insects in nature.

Among the most popular displays are those in which visitors can actively participate: pulling out drawers to find answers to quiz questions; stepping onto a scale to see how many insects equal their weight; or sliding moveable magnifying glasses over specimens to have a closer look. Visitors especially enjoy insect demonstrations conducted by Insect World employees and zoo volunteers where selected live arthropods can be picked up and held for even closer examination.

One of the highlights of the Insect World is the butterfly "aviary" where visitors actually enter the enclosure which houses the insects. Represented here is a jungle clearing in which Heliconiid butterflies and hummingbirds can be seen surrounded by lush tropical vegetation including orchids, bromeliads, trees, and flowering vines.

Live specimens displayed in the Insect World are obtained by several methods. Commercial suppliers provide certain moths, butterflies, and stick insects. Numerous exchanges of specimens have been made between the Cincinnati Zoo and several museums, universities, and other zoos. In addition, insects are acquired by donations and collecting trips, both local and tropical. These sources provide important fresh material for display and for the development of new rearing techniques and life history investigations.

Many factors enter into insect colonization, display maintenance. Most of the 63 live displays are serviced daily from the public side by sliding them forward out of their wall mount locations. Cage construction consists of a plywood bottom with a wood moulding around the front and sides, a molded fiberglass back, a glass front, and a hinged plexiglass lid with one or two screen ventilation panels depending on cage size.

Certain species can be reared in continuous cultures in the display cages (milkweed bugs, *Oncopeltus*; flour beetles, *Tribolium*; Collembola; chafer beetles, *Pachnoda*; various cockroaches; etc.). But most of the approximately 100 species of Arthropods at the Insect World are keps in breeding cages in the service area and transferred to display cages at the appropriate stage of development. A greenhouse is used to raise Heliconiid Butterflies and to grow foodplants for phytophagous insects during Winter.

A discussion of rearing techniques for a few particular insect species may serve to illustrate a number of key considerations for insect propagation under display conditions. The arthropods displayed at the Insect World fall into three general rearing categories: 1. continuous culture (with overlapping generations), 2. seasonal rearing (or non-overlapping generations), and 3. maintaining individuals (not reproducing in captivity).

Among the insects which are raised in continuous culture, the Heliconiid (passion-flower) butterflies from the New World tropics are good examples of many considerations which must be accommodated when rearing and displaying insects. The adult butterflies are provided with flowers which provide a sufficient amount of nectar (e.g. *Lantana*) and pollen (e.g. *Anguria* and *Gurania* -- both tropical Cucurbits) from which the butterflies extract amino acids. Sugar-water feeding stations can be provided in emergencies. Larval foodplants (passion-flower vines) are placed in oviposition cages. *Passiflora caerulea* and *P. biflora* have been the two most useful and versatile species of Heliconiid foodplants at the Insect World. Several predator species which have depressed butterfly populations at the Insect World include: Pharaoh ants, Carpenter ants, and Pillbugs which prey upon eggs, larvae, and pupae; jumping spiders and wolf spiders which attack larvae; and various web-spinning spiders which prey upon adult butterflies. Since the use of insecticides in an insect exhibit poses obvious hazards, cultural and biological controls are used whenever possible.

Another of the permanent displays is the honeybee colony. The bees are allowed to forage outside, however, since it is a small colony (five frames) supplemental feeding (sugar, syrup and pollen substitute) is usually necessary during late Winter and early Spring.

One of the highest maintenance of the continuous culture species is the Leaf-cutting ant colony (*Atta columbica* -- one of the fungus culturing species of ants). The display colony at the Insect World requires literally an armload of leafy branches every day throughout the year. Fresh branches are used during warm months. Frozen leaves, greenhouse plants, and evergreen shrubs are used during the Winter. Plant preferences of the ants change from day to day so leaf species must be provided on a rotating basis. Also, moisture and temperature levels in the fungus garden chambers must be closely watched and adjusted appropriately.

Several species of stick insects are reared and displayed in continuous, overlapping generations. Among these are the Javanese leaf insect (*Phyllium*) and the Giant Asian walkingstick (*Eurycnema*) both of which have year-long life cycles. Since the eggs incubate for six months, overlapping generations are essential to keep these species on display. Another more extreme example of long development time is the Malaysan leaf insect (*Heteropteryx*) which has a two-year generation (eggs incubate for nine months).

Among the predatory species displayed, one of the more unusual is the hematophagous bug, *Dipetelogaster maxima*, from Baja California believed to be the largest blood-sucking bug in the world. This species requires a blood meal at each nymphal instar and at monthly intervals during the adult stage.

The Hickory-horned devil or Royal walnut moth (*Citheronia regalis*) is one of the local species in the Cincinnati area which is displayed on a seasonal basis limited mainly by foodplant availability.

Another seasonal species at the Insect World is the giant Hercules Beetle (*Dynastes hercules*) of the New World tropics. Males can be easily distinguished from females by the presence of a pair of long, forward-directed horns -- one on the prothorax and one on the head. Mating was observed between some individuals. In unmated females, hand-pairing was done to insure the development of fertile eggs. Eggs were laid in captivity in a substrate consisting primarily of composted leaves and decayed black locust wood. Eggs began hatching in about three weeks and larvae fed on the compost-wood mixture in the oviposition cages. Larval growth and development required about 18 months. Three larval instars were observed, and mature larvae ranged in weight from 51.6 grams to 101.2 grams. Larvae pupated in earthen chambers formed in the compost substrate within the rearing tanks. Pupal development required about two months with male and female pupae differing in appearance primarily by the presence of the prothoracic and cephalic horns in the male. Adults remained in the pupation chambers for a period of time after eclosion presumable awaiting the onset of the "rainy season" when they would normally appear in nature. Adult males, at emergence, ranged in weight from 29.2 grams to 33.5 grams and in length from 11.0 cm to 12.3 cm. Adult females ranged in weight from 13.4 grams to 27.6 grams and in length from 5.7 cm to 6.3 cm.

In conclusion, the Cincinnati Zoo's Insect World was designed to be an attractive and entertaining educational exhibit which would introduce visitors to insects. The Insect World is well suited for use as a teaching aid for Entomology or Animal Behavior classes. We have learned much about insect display and rearing and continue to learn while at the same time the displays allow visitors to have a close look at living insects and learn what insects are, how they have adapted to survive, and how they interact with plants and other animals in nature.

IMPROVED HUSBANDRY TECHNIQUES FOR NOCTURNAL ANIMALS

Michael W. Dulaney, Headkeeper, Nocturnal House, Cincinnati Zoo

Because of the diversity of nocturnal animal life in the world, a nocturnal building has the potential of displaying a large variety of creatures encompassing every class of animal life exsisting today. Along with this potential goes the problems of special husbandry techniques often involved with many nocturnal species. Because of these special needs many zoos have chosen not to display animals which will not or do not convert to being active or displayable under "normal" zoo conditions. Some zoos have set aside a portion of a building (usually a Small Mammal House) as a nocturnal section while others have created specific Nocturnal Animal Houses. Such is the case at the Cincinnati Zoo where, in the mid 1960s, the Zoo's Blacksmith Shop was converted into the present day Nocturnal House.

Having an approximate 3,150 square foot floor space, the Blacksmith shop was an ideal area to create a building which had a relatively new concept in the zoo field at that time. That concept being to reverse the day/night light cycle in a display situation. Theoretically this would allow the public to view animals which were awake and active who, under ordinary conditions, would be asleep. Since its' creation the Nocturnal House has proven to be not only a very popular display area with the public but also a viable means of presenting to them some of nature's most interesting animal species.

Beginning in 1980 a cage by cage re-evaluation and upgrading was initiated within the Nocturnal House, The primary purpose of these renevations where... 1) to better meet the needs of those species which were considered as long term displays; 2) construct displays for new species which were planned, and 3) to improve the displays themselves not only for the animals' benefit but for the publics' as well.

One of the major problems with 10 of the 12 displays originally incorporated into the building was that they were almost exactly the same. The fact that they were similar wasn't the problem as much as they all resembled the inside of a cave, and not a very close resemblence at that. These exhibits measured 6' long by 3' deep and 4' high. Each display unit sat on whhels fitted into tracks attatched to the floor of the building. The "cave" appearance was achieved by attatching a lathing screening to the inside of the metal shell or frame of the three sided enclosure. By shaping the screening and applying a liquidy form of concrete, commonly referred to as gunnite, a roughened rocky texture is created. These "roll out cages", so named because they rolled back away from the stationary public viewing window, weighed over 1,000 pounds each.

When these cages were rolled back the keeper had access to the display for cleaning purposes and could also service the inside of the display window. The major disadvantage with these types of displays is that the inhabitants of theses enclosures frequently would climb or fall out of the exhibit as it was rolled back, or, when closing the exhibit, curious animals that might extend their heads or bodies outside of the enclosures' perimeters could be pinned between the exhibit and window.

Probably the single most important aspect of creating a successful nocturnal display is the lighting of that display. Too soft a lighting causes the display and its' inhabitant(s) to be difficult to view. Too bright a lighting and you risk having the animals not adjusting to the reversed light cycle and therefore sleeping through the majority of the public viewing hours. Even under optimum lighting conditions one should keep in mind that most nocturnal animals have peaks of activity shortly after dusk and prior to dawn. In the wild this is the time that they would hunt for food, seek out a mate, ecetra, and will often spend large amounts of time in between simply resting. In most cases where nocturnal animals have been kept under a reversed lighting situation the usual lighting of the pseudo night has been achieved by using red colored bulbs. This had been the color of choice in our Nocturnal House prior to 1980. It was during that year that we had begun experimenting with diffrent colors, shades and intensities of lighting.

Nocturnal animals in general are color-blind, the inner workings of their eyes containing primarily the light receptive rods rather than the cones which perceive color. This gives these animals better total vision under reduced illumination situations. While the red lighting was sufficent to achieve the desired effect of creating an artificial night, so far as the animals were concerned, however, the lighting was harsh to view the animals under and it also gave the exhibit an unnatural red appearance. There had also been some concern that animals kept under red lighting have a greater tendency to develop cataracts (Glatston, 1981).

We elected to change to blue lighting for it created a more natural and pleasant lighting situation and simulated better a dusk or dawn colored environment. Several factors were taken into consideration to determine the types of bulbs and wattages to use for each display. Though in many displays a blue fluorescent strip light is sufficent we have also used incondescent blue bulbs of wattages ranging from 15 to 100 watts as well as blue outdoor spot-lights. The spot-lights are less subject to breakage if gotten wet and also do not throw off as much heat as the incondescent bulbs. The spot-lights also allow us to direct the light where desired.

One by one the original cages were moved out of the building and construction of new displays built around the concept of a pre-determined specie or species of animals was begun. One of the two displays in the building which was not of the roll out variety was also abandond to make way for a new exhibit..The original display had a viewing window which faced the main lobby doors to the building. This meant that whenever the lobby doors were opened the display received a large amount of natural lighting. Though originally set up to display nocturnal animals under white lighting (I.E. non-active, asleep), viewing was very difficult due to the bright glare on the glass.

This exhibit sat within a 12' deep by 8' wide and 12' high room. We wanted to create a display to utilize the space available and also to display taxa other than mammals which dominated the rest of the building. We chose, therefore, to create a naturalistic display for Barn Owls (Tyto alba). The room was transformed into a display resembling the inside of an old barn, complete with hay loft, bales of straw and old farming tools. Natural barn wood was used as well as many items that might be found in a barn to give a look of authenticity. The birds would be kept under a 12 hour day / 12 hour night light cycle. A 4' blue fluorescent strip light illuminates the exhibit from 1000 h. to 2200 h. while a 4' white fluorescent strip light is on from 2200 h. to 1000 h. The temperature within the room ranges from 65 - 75° F.

A young pair of Barn owls were placed in the exhibit on 27 March 1980. They are fed once daily and are offered, along with Nebraska Brand Bird of Prey Diet, chicken necks (skin removed); beef heart strips; day old chicks and mice (the latter two items being pre-killed and frozen until needed). This single pair, since 1981, has produced and fledged some 50 offspring within the display. We have found that by increasing the amount of food to the parent birds during the raising process that we can control, to some extent, the number of offspring which they will raise. By increasing the food supply only slightly a maximum of 2 young per clutch is usually reared. By offering a substantial food increase we have had several clutchs of 5 young fledged (Dulaney, 1985).

Presently the only remaining roll out cage in the building houses a group of 24 Vampire Bats (Desmodus rotundus). The interior of the exhiibit has been modified to include a smoother, more cave-like appearance complete with stalactites and stalagmites. A 1' square roosting box sits on top of the exhibit. The majority of the bats prefer to stay clustered inside the secluded roosting box while a few others will remain on exhbit, possibly acting as sentries. The major problem with keeping Vampire bats is the ability to acquire a fresh source of blood for them to eat.

Located within the city of Cincinnati are several meat packing houses which permit us to make weekly collections of cattle blood. Once the blood is collected from the cattle, and while still warm, it should have the coagulation units of the blood removed to prevent clotting. This can be accomplished by collecting the blood in a clean vessel and stirring briskly, by hand, with an upward motion while having the fingers slightly spread opened. Within a few minutes of stirring some of the blood becomes clotted together and stringy. This part is discarded and the remaining liquid is placed into a suitable container and refrigerated.

Under refrigeration the blood can be stored for up to two weeks. A means of keeping the blood for longer durations would be to freeze the defibernated blood. Our method of feeding the vampire group consist of pouring enough blood into a shallow bowl to provide each bat with about ½ ounce of blood. Liquid multivitamins (Petdrops) are added at a ratio of 1 drop of vitamins to every 2-ozs. of blood. The blood is not warmed and is offered to the bats in the late morning hours and remains in the display until removal of the bowl takes place the following morning. The majority of the blood, however, is consumed by late afternoon.

Early attempts at locating an easily accessible food source for our vampires included using out-dated human blood from local hospital blood banks. Because of the age of the blood this proved to be an unsatisfactory solution as a food supply. The cattle blood is preferred not only because of its' freshness but also because vampires in the wild often feed on cattle blood. Our vampire colony has been self-sustaining since its' collection in the mid 1960s. However, for a period in 1982-1983 we began to see a high infant mortality rate (90%) of animals from 1 day to 6 months of age. The problem was thought to have been due to inbreeding. The addition to the colony of several wildcaught individuals in 1983 seems to have corrected the problem.

Another display in the building now resembles an old mine shaft entrance of the western United States region. The exhibit includes a flickering lantern, old powder keg and boarded off entrance to the shaft itself, set into a stony hillside. This display houses Ringtailed Cats (Bassariscus astutus), also referred to as "miners' cat" because of its' habit of settling in areas close to where the miners live and work. The Ringtailed cat display is one in which we first added a new dimension to some of our exhibits. The display drops back about 4' from the viewing window and at a height of about 6' has an elevated hilltop or plateau which goes back another 3-4'. This gives the animals many times the room that they had experienced in their old exhibit and allows them to utilize their climbing agility.

The display is equipped with an elevated nesting box in the upper left hand corner in the rear of the enclosure. With few exceptions, the exhibits in the Nocturnal House, like that of the ringtails, has a temperature range of between 75 - 85° F. with the average enclosure temperature being about 78° F. Along with fresh water the ringtails receive daily a diet of Nebraska Brand Feline Diet with slices of orange, apple, banana, and cooked carrot added. Though naturally active animals our Ringtailed cats also receive live crickets (Acheta domestica) to supplement their diet and to provide added activity stimulus.

Though similar in shape to the exhibit housing the Ringtailed cats, the enclosure for a trio of melanistic Grand Galago (Galago crassicaudatus argentatus) has more of a rocky cliff appearance. Jutting out from the rock work (which is actually several fiberglass panels pieced together) are several tree branches. A small recirculating pump carries water from a pool in the floor of the exhibit to a height of 7'. The water then pours back into the pool, over the rocky ledge, to form a small waterfall. The galagos tend to frequent only the uppermost portions of the exhibit and so, in order to attract them to lower parts of the exhibit, where the public has a better view of them, they are fed from shallow pie pans on the display floor. A variety of chopped fruits and vegetables as well as several golf ball size pieces of Nebraska Brand Feline Diet is offered in the early afternoon. The galagos show a marked preference for the meat over the other food items offered.

In several displays within the Nocturnal House we have used a bended $\frac{1}{4}$" masonite sheet as a back wall to eliminate corners from the exhibit and to give a better perception of depth. A display housing a breeding group of Demidoff's Galago (Galago d. demidovii) as well as a colony of 11 Pallid Bats (Antrozous pallidus), though only 3' deep, utilizes this concept well. Each of the galagos are provided with an individual nesting box which is out of public view by being attatched to the front of the display directly above the viewing window. A recirculating pump operates a small stream which runs through the middle of the exhibit. Several small trees and inter-connecting vines as well as fresh cut and plastic bamboo plants are placed in the display for cage "furnishings". Couple all this with a bamboo jungle mural painted on the rounded back wall and you have a natural looking exhibit which is functional and condusive to a breeding situation (Dulaney, 1985). Since our first Demidoff galago birth in July of 1984 we have had a total of 5 babies born to two diffrent females. The most recent birth occurring on 4 July 1985.

The Pallid bats were placed in the exhibit with the galagos in January of 1985. Though originally provided with a roosting box suspended from the ceiling of the exhibit, the bats prefer to cluster directly under the display window amongst a group of bamboo stalks. The galagos are fed from a shallow pie pan placed upon an elevated shelf in the rear of the exhibit. Included in their diet of finely chopped fruits and vegetables is small pieces of Nebraska Brand Feline Diet, Zu/preem canned Feline Diet, Zu/preem canned Primate Diet as well as frozen crickets and mealworms (Tenebrio sp.) (thawed). A plate of pre-mixed insectivorous bat diet is placed on the exhibit floor for the Pallid bats. This diet consist of the following ingredients: Cottage cheese; Zu/preem canned Feline Diet; hard-boiled egg; banana; Beech - Nut Hi-Protein Baby Cereal and Zu/preem canned Primate Diet, blended into a soupy mixture. Frozen crickets and mealworms (thawed) are mixed with this "bat glop" prior to feeding and live crickets are furnished daily for both species inhabiting this display.

Our Fennec Fox (Fennecus zerda) exhibit has utilized the bended masonite in a diffrent dimension by incorporating it into the ceiling design of the display. This allows for a mural scene depicting the on going vastness of a desert region. The exhibit is made to resemble a rolling sand dune. Built within the smooth concrete dune itself is a 6' long nesting box which can be divided into as many as four seperate sections if the need arises. Entrance to the nesting area by the animals is either through a burrow hole set on top or through a similar hole placed on the side of the sloping dune. The two pair of fennecs currently housed in the exhibit receive a similar diet as to the one fed to the Ringtailed cats. Live crickets are offered daily and less often the foxes receive Anole Lizards (Anolis carolinensis) to supplement their diet and to increase activity in the exhibit. The diet is also supplemented at least once weekly with either frozen mice or day-old chicks (thawed).

A group of five (3/2) Philippine Tarsiers (Tarsius syrichta) have been on display in the building since their arrival in May of 1985. In preparing an exhibit for them there were several criteria we wanted to meet which were felt to be necessary to the animals survival in captivity. These special needs included a warm enclosure with high humidity, several verticle perching or resting sites and a selection of live food.

Our Tarsier exhibit is 8' tall by 8' deep and 7' wide. A dozen natural bamboo poles, 1-2" in circumference and extending from floor to ceiling, are spaced throughout the exhibit. Those poles closest to the 6' long by 4' high viewing window allow the animals to escape the curious eyes of the public since they rise several feet above the publics' view. While most of the newly constructed exhibits in the building are equipped with a 12" ventilation fan, such is not the case with the Tarsier exhibit. Though the temperature inside the Nocturnal House ranges from about 70 - 85° F. the internal temperature of the Tarsier exhibit ranges from 80 - 90° F. with the average temperature being about 85° F. In order to maintain a high humidity in the exhibit a 4' tall rocky waterfall splashes into a shallow stream that runs from the rear of the exhibit to the front. A cypress bark mulch, which retains moisture without rotting, covers the exhibit floor and collects excess moisture from the waterfall spray. The combination of the warm exhibit, running waterfall and moisture laddend substrate keeps the relative humidity of the exhibit at about 85% (ranges from 80-90%).

Tarsiers are said to feed almost exclusively on live prey and are reported to observe their potential prey moving about and at the right moment leap upon it and quickly overpower it. Several food items are offered to our tarsiers, these include not only crickets, mealworms and anole lizards but also such delicasies provided by our Insectarium as Gray-bird Locust (Schistocerca vaga) and Hissing Cockroaches (Gomphadorina portentosa). Pink mice had also been offered and consumed occaisonally. Our tarsiers' favorite food item seems to be the locust followed by crickets, lizards, cockroaches and mealworms. The hissing cockroaches are a new addition to the diet but since they have more of a tendency to burrow the tarsiers do not have a great deal of access to them, however, there consumption by the tarsiers has been observed. Except for the mealworms (which are placed in shallow bowls or feeding stations throughout the exhibit) the food items offered are set free within the display. Though our tarsiers seem to feed the most shortly after the white light cycle has been extinquished (1000 h.) we feel it's important to keep a selection and quantity of food items available at all times. In order to offer food high in protein the food items themselves are fed high protein foods, therefore passing on their protein intake to the tarsiers.

Of the three species of tarsier recognized today the Philippine species is thought to be, by many, the more active, and, also the less aggresive toward conspecifics. Our group of 5 animals have been housed together since their arrival and we have witnessed no signs of aggressive behavior. In fact, sometimes as many as three individuals can be found resting on the same pole, sitting almost on top of one another.

For identification purposes shortly after their arrival a plastic wrap around leg band was placed on each tarsier. Males received a colored band on their left leg while females received a colored band on their right leg. Each tarsier is weighed on a monthly basis by capturing them in a small net and quickly transferring them into a cloth bag to aid in keeping them calm. Weights on our animals have ranged from as low as 87 grams for one animal to as much as 124 grams for another.

Whenever possible we have tried mixed species exhibits in the Nocturnal House. Many times the animals mixed will share the same geographic location in the wild, other times it may just be the compatibility of two or more species which causes the animals to be displayed together. Our South American exhibit is a mixture of 1/1 Hoffman's Sloth (Choloepus hoffmani), 1/1 Owl Monkey (Aotus trivirgatus), 1/1 Acouchi (Myoprocta acouchy) and 0/3 Four-eyed Opossum (Philander opossum). The exhibit measures 8' deep by 10' tall and is 8' wide. There are several large vines and tree limbs for the animals' use and each opossum has an elevated nesting box. With the exception of the opossums all other species in this display have reproduced.

The arboreal species in the display retrieve their food from hanging baskets in the exhibit and while the acouchis will often consume food that drops from the baskets they do receive a plate of their own diet placed on the floor of the exhibit. A salad mixture of chopped fruits and vegetables is provided to the exhibit with meat (Nebraska Brand Feline Diet) also included and consumed by all species in the exhibit. Monkey biscuits and a parrot-mix of various seeds are included for the Owl monkeys and acouchis respectively.

Australia is represented by our Eastern Native Cat (Dasyurus viverrinus) and Echidna (Tachyglossus aculeatus) display. One of two pairs of native cats currently at the Nocturnal House share a display with the well protected echidna. The native cats, being carnivorous marsupials and not cats at all, have done well on a diet consisting of meats such as Nebraska Brand Feline Diet and Zu/preem canned Feline Diet but also receive such items as beef heart strips, mice, chicks, fish and anole lizards. These very attractive Dasyuridaes are fed six days a week and have shown no interest in harassing the echidna.

This exhibit measures 6' tall by 4' deep and is 7' long. It is equipped with tree branches and vines for the native cats to climb on, hollow logs to den in, a rock boulder to rest on and a shallow pool (3' long by 1½' wide by 3" deep) where occaisonally live minnows and/or goldfish can be placed. The native cats are also very fond of live crickets which they will chase tirelessly.

The echidna is content to move about very little and usually only does so to make his daily trip to his food container. Approximately six ounces of a high protein gruel mix is fed to the echidna. The contents of this mixture include: Purina High Protein Dog Chow; Nebraska Brand Feline Diet; hard-boiled egg yolk; evaporated milk; Nutrament; honey; Rib-AD and water blended together.

Two species of bats share an exhibit which is 17' long, 7' tall and 3' deep. Though from diffrent continents the Spear-nosed Bat (Phyllostomus hastatus) and the Egyptian Fruit Bat (Rousettus aegyptiacus) have proven to be compatible and both species are currently reproducing. The exhibit is actually divided in half by a concrete "hillside". This has permitted the creation of a jungle scene for half of the exhibit with vines, live bamboo and plastic plants. Bended ¼" masonite back walls have a bamboo mural painted on the otherwise flat-black colored surface. The bats can fly through a 1' circumference hole in the hillside in order to enter the cave half of the display, complete with dripping stalactite.

These two species of bats were placed together in 1983 in this exhibit primarily because... 1) the Spear-nosed bats have a tendency to feed on bats smaller than themselves and 2) the Egyptian bats could manoeuvre so well within the exhibit and therefore enhance the display with their activity. Currently about 15 adult individuals of each species occupies the exhibit. Though they originally segregated themselves to opposite ends of the display the majority of both species now roost side by side.

Three flat food pans filled with small pieces of fruit and meat are placed on the floor of the exhibit. Because of the large number of bats in the display this allows a good number of them to drop to the floor, circle the plate, retrieve the desired food item and return to the security of the vines. This method has reduced squabbling during feeding times since more bats have access to the food plates.

The largest display of the Nocturnal House (14' wide by 8' deep and 8' high) houses a mixed species group of animals consisting of a pair of Aardvarks (Orycteropus afer), 2/5 Indian Giant Fruit Bats (Pteropus gigaenteus) and a pair of Mongoose Lemurs (Lemur mongoz). The basic design of this exhibit has changed very little, the only exception being the addition of a small running stream in the rear of the display. This provides the inhabitants with a fresh water supply. A water bowl or recirculating pump stream is not practicle due to the large size of the aardvarks and their potential water intake. They could leave a bowl or recirculating stream dry or severely depleated. In the case of a pump this could cause motor burn-out and in either case would reduce water availability to other animals in the exhibit.

Several dead portions of trees were originally placed in the exhibit which provided climbing areas for the lemurs and roosting areas for the bats. The trees were intertwined with natural grapevines primarily for the bats' locomotion. Though the bats moved about the exhibit for the most part by climbing through the trees and vines often times they would attempt to fly in the exhibit. This prooved to be a problem in that many of the bats were tearing or puncturing their wings on the tree branches. Another problem with the trees surfaced when the aardvarks became playful or curious and would either bump the trees as they ran about the exhibit or they would deliberately jump up on the "trunk" area of the tree, usually sending the tree to the ground.

The tree problem was rectified with their removal and replacement with several rope "vines" extending from the ceiling of the exhibit. Both 1" and $1\frac{1}{2}$" thick heavy duty braided rope was strung throughout the display, criss-crossing and intertwinning at several sites. The rope was coated with a brown pigmented fiberglass resin to make the artificial vines more realistic and to increase the lifespan of the rope. Despite the fiberglass coating the natural roughness provided by the braids still gave ample footing for the lemurs to climb about and the bats to hang from. The bats were able to manoeuvre the ropes very well whether they were climbing or flying. With the removal of the trees the natural perching and sleeping areas of the lemurs was also removed. A 1' square nesting box with a 1' square by $\frac{1}{2}$" thick plywood ledge was attatched to the ceiling of the exhibit and serves well as a secure area for the lemurs. The bats and lemurs are both fed from hanging baskets which are hooked to the rope vines while the aardvarks' food is placed in a large metal bowl on the exhibit floor.

The fruit bats reproduce regularly and our female aardvark has given birth to a total of four young since 1980. Her fourth offspring (born 28 October 1984) became only the second aardvark born in captivity to be reared by its own mother (Dulaney, 1985), a feat which occurred in the exhibit with the other species of the enclosure present. The only changes made were the removal of the sire and the addition of a 3' square by $2\frac{1}{2}$' high nesting box to provide the female and young some security.

A service closet in the lobby of the building has been renovated to create a naturalistic looking display for a pair of Screech Owls (Otus asio). The shallow exhibit uses the curved masonite wall technique with the masonite being painted a flat-black to give an increased appearance of depth. A large natural dead tree trunk, complete with a hollowed roosting cavity sits in the middle of the closet, taking up nearly half of the total inside width and depth of the enclosure. A small wattage light is suspended from the inside top of the hollow roost to illuminate it. Several small tree branches provide perching areas outside of the roosting hole and a hollow piece of wood serves as a hiding spot for a water bowl. These owls, both wildcaught as adults, are offered dead mice, one per bird daily, six days a week except during extremely warm weather when they have a tendency to reduce greatly their food intake. During these times they are given food every second or third day.

Within this paper I have tried to touch briefly on some of the changes which have improved the husbandry techniques in our Nocturnal House on an exhibit by exhibit basis. Though we admittedly display a very small portion of nocturnal animals available for exhibition many of the techniques which we now employee could be utilized for a wide diversity of species. With the number of nocturnal animal species being so great and diversified, a nocturnal building or even section of a building, is a justifiable addition to any zoo!

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PRODUCTS MENTIONED IN THE TEXT:

Beech-Nut Cereals: manufactured by Beech-Nut Cereal Corporation, Fort Washington, Pennsylvania 19034, U.S.A.

Nebraska Brand Diets: manufactured by Central Nebraska Packing Company, P.O. Box 550, North Platte, Nebraska 69101, U.S.A.

Nutrament: manufactured by the Drackett Products Company, Cincinnati, Ohio 45232, U.S.A.

Petdrops: manufactured by The Upjohn Company, Kalamazoo, Michigan 49001, U.S.A.

Purina Hi-Protein Dog Chow: manufactured by Ralston Purina Company, Checkerboard Square, St. Louis, Missouri 63188, U.S.A.

Rib-AD: vitamin - mineral powder manufactured by Vitamin Mineral Products Company, Peoria, Illinois 61601, U.S.A.

Zu/preem Diets: manufactured by Hill's Pet Products, P.O. Box 148, Topeka, Kansas 66601, U.S.A.

BEHAVIOR OF A PAIR OF CHINESE GOLDEN MONKEYS
(*Pygathris* [*Rhinopithecus*] *roxellanae*)

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A pair of Chinese golden monkeys were loaned to the San Diego Zoo for six months through an exchange program with the Chengdu Zoo. This was the first time members of this little known species have been exhibited outside of China. We undertook studies of their social interactions and vocalizations.

These mysterious primates arrived accompanied by an 11 member Chinese delegation. Two of these, a veterinarian and keeper, remained with the animals throughout the entire visit.

The golden monkeys were displayed in a large glass enclosure located in the San Diego Zoo's recently constructed Southeast Asia exhibit. Since their enclosure was isolated from others, the pair were exhibited even through their quarantine period. The observations in this study were made from the bedroom loft area overlooking their enclosure.

The male was a 10 year-old wild-caught animal. The female, only four years-old, was born at the Chengdu Zoo. The pair were housed together for several weeks to ensure their compatibility before they were sent to San Diego. The male arrived weighing 16.8 kg while the female weighed only 6.4 kg. Other dimorphic features included the male's magnificent cape of golden-orange hair, over a foot in length, and his "lip-flaps" located on the upper lip corners.

During our observations, the pair spent about 30% of their time grooming each other. The male initiated at least 80% of the grooming sessions and the female rarely groomed him unless he had groomed or mounted her just before. Lip-smacking, especially by the male, was frequent during grooming sequences.

One of the most fascinating features of this pair was their vocalizations. They included wailing, resembling that of a human baby, and an assortment of squeals, whines, and hoots. The characteristic which makes these calls especially unusual is that most of them are made without any accompanying mouth or facial movement (Tenaza & Fitch, in preparation) These eerie calls are transmitted through the extremely enlarged nostrils of their upturned noses. Since there was usually no visible sign of either animal vocalizing, it was initially impossible to determine which was actually making the individual calls. Only after observing the animals closeup in their separate bedrooms were we able to accurately identify the vocabularies of each.

Many of the calls made by the pair blended together into duets. These duets usually began with a squeal from the female immediately followed by stutters and wails by the male. It is impossible to judge if these calls are actually duets similar to monogamous primates such as gibbons and titi monkeys based on observations of just one pair. It may be that a whole group of golden monkeys tend to vocalize together in the wild.

The male often performed a curious behavior called "head-butting" when he approached the female to mount or groom her (Fitch, Tenaza, & Lindburg, submitted). He approached her from behind and bumped his forehead against her back. This was often followed by a quick wiping of the side of his face on her fur. It appeared that he deliberately rubbed the enlarged red lip structures on the female. This behavior leads us to suspect that these lip swellings may be glands used to mark the female but histological and chemical examination are necessary to confirm this idea.

Most of the time the golden monkeys spent resting was in an embrace posture (hugging) which was initiated by both animals with equal frequency. Besides being an effective way to conserve and share body heat, it also appears to represent shared affection (Qi, 1982; Davison, 1982; Poirier & Hu, 1983).

In the wild, golden monkeys are reported to feed on over 100 various types of leaves, fruits, and flowers. Qi (1982), Davison (1983), Poirier & Hu (1983) At the San Diego Zoo, the monkeys main diet was given in separate quarters so that their intake could be monitored. Mulberry and eugenia leaves were distributed to the pair while they were together in the exhibit. The female gathered piles of leaves and carried them to a private place to eat alone. The male followed close behind and attempted to steal the leaves from her hands. During the first several weeks, the female allowed food to be taken from her, but eventually she successfully resisted the males attempts, and even began to take food from him.

Breeding behavior was observed in both March and April during the golden monkeys' visit. The female's estrus was confirmed through hormonal analysis of urine samples collected from the clean floor of her bedroom. She became very active during these periods. After a rapid dash about the enclosure, she would suddenly lie prone on a flat surface with her posterior towards the male. The male would then copulate with her. Semen residue left in their enclosure was found to contain abundant sperm cells. The pair departed for China shortly after the last matings were observed and there have been no reports about possible pregnancy at this time.

Our observations of these golden ventriloquists have raised many interesting questions which can only be fully understood through further study of this species in the native habitat.

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RON GARRISON-ZOOL. SOC./SAN DIEGO

The pair together. Note the size dimorphism (female on left).

KEN KELLY-ZOOL. SOC./SAN DIEGO

Note the male's lip flaps (red in life) and cape of long hair.

RICHARD TENAZA

Male grooming the female.

Figure 1.

ENCLOSURE UTILIZATION, ACTIVITY BUDGETS AND SOCIAL BEHAVIOR OF CAPTIVE CHAMOIS DURING RUT

Forthman, Quick and Pappas

ABSTRACT

An observational study of chamois behavior during the rut was conducted at the Los Angeles Zoo. At the time, the herd consisted of an adult male, two adult females, two subadult females and two kids (1.1). During the 13 week study, observers collected scan data on all animals, and recorded all occurrences of selected social behaviors during interactions which involved the adult male. Scan observations showed that open areas of the enclosure close to the public were the least preferred, and areas with good rest places were used most. Overall the herd spent 73% of their time stationary, 13% foraging/feeding, 6% moving, and less than 5% each in object investigation, maintenance, play and social behavior. The adult male rested and fed less, and stood vigilant and engaged in social behavior more frequently than the others. Nearest neighbor data showed clear patterns of kin association beyond the mother-last kid bond. The adult male interacted most closely with the regular keepers, the subordinate female and oldest subadult female. Interactions with the females consisted mostly of herding and sexual behaviors, while those with the keepers consisted almost exclusively of competitive/aggressive behaviors. While most findings paralleled those from studies of wild chamois, no study has previously reported long lasting associations among kin. Because the behavior shown by male ungulates during the rut occurs even in the absence of appropriate social stimuli, the maintenance of two adjacent males and their herds in captivity might reduce the incidence of inappropriate aggression to immature chamois and animal keepers.

INTRODUCTION

The Rupicaprini tribe, in the subfamily Caprinae, consists of four genera, represented in North America by the Rocky Mountain goat (*Oreamnos americanus*), in Europe by the chamois (*Rupicapra rupicapra*) and in Asia by both the goral (*Nemorhaedus* spp.) and serow (*Capricornis* spp.). Knowledge of the behavior of this group may aid in the formulation of programs for their management, as now the *ornata* race of chamois and the Sumatran serow, *Capricornis sumatraensis*, are endangered (Nowak & Paradiso, 1983).

While several studies have described the behavioral ecology of free-ranging chamois (Altmann, 1956; Grzimek, 1972; Knaus and Schroder, 1960; Kramer, 1969), comparatively little has been published with regard either to the social interactions within a group, or to the behavioral adjustment of chamois to captivity (Vestal and Vander Stoep, 1978; Weisner, pers. comm.).

The studies conducted describe wild chamois as highly social animals which have an open, flexible social organization, except during the rut, when adult males are intolerant of other males older than one year (Kramer, 1969). However, wild males are usually able to avoid serious injury either through lengthy and ritualized displays, or by flight over terrain which offers adequate physical and visual refuges (Knaus & Schroder, 1960; Weisner, pers. comm.).

In captivity, chamois present management problems due to their potentially lethal weaponry and behavior. Unlike true goats, sheep and other bovids (Vestal and Vander Stoep, 1978; Walther, 1972), once a confrontation escalates to physical attack, combat is relatively unritualized. To deal with these problems, many zoos hold a single adult male and sometimes must isolate individual animals temporarily or permanently. Another approach suggested by Weisner (pers. comm.) is to keep chamois in large enclosures with considerable variation in topography.

The Los Angeles Zoo (LAZ) has twice experienced difficulty during the rut in the husbandry of an otherwise compatible herd of chamois. In each case, a daughter (not the same one in both instances) was singled out by the adult male for repeated aggression. In order to provide information which might be useful for their management, an observational study was conducted on the LAZ herd. We hoped to obtain information about activity budgets, enclosure utilization and the social dynamics of the group during the rut. From initial observations, we hypothesized that:

1) patterns of enclosure utilization are non-random
2) activity varies over time and according to age/sex class
3) there are definite patterns of association within the herd
4) the adult male does not direct social behavior equally to each member of the herd

METHODS

During the course of this study, which spanned 13 weeks between November, 1983 and February, 1984, the LAZ herd consisted of 7 animals. They are kept in a hillside exhibit approximately 3,000 m2 in size. The enclosure contains trees and is terraced with stone walls (Fig. 1). Animals are fed fresh acacia browse in the exhibit between 0830 and 0900 and hay and grain in the barn around 1200. They generally have access to the barn at all times.

(See Figure 1.)

Due to variability in features of horns and throat patches, all animals could be individually identified. There were three adults, a male and dominant female, received at the LAZ in 1975, and a subordinate female, received in 1979. All were from the Oklahoma City Zoo. The other four animals were their offspring. The dominant female had three young, a two year old female, a one year old female, and a four month old male kid. The subordinate female had a single six month old female kid.

Five trained observers collected 90 hours of data during 1 h samples taken between 0900-1630 h for the duration of the rut and for two weeks thereafter. The rut was identified by certain behaviors exhibited by the adult male: periods of concentrated vigilance, aggression towards humans, and herding and/or courtship of females. Instantaneous scans were made of all animals at 10 min intervals. Location, activity and the identity and distance of the nearest neighbor were recorded. The activity categories used were PASSIVE (standing, eyes open), REST (lying, eyes open or closed), MAINTENANCE, OBJECT INVESTIGATE, MOVE, PLAY (auto or social play), FORAGE/FEED (excluding rumination), and SOCIAL (affiliative, aggressive or sexual behaviors). In addition to the scan samples, all occurrences of pre-selected social behaviors observed during interactions between the male and other chamois or keepers were tallied during successive 5 min intervals. Data were summarized by week and/or age/sex class. Enclosure utilization data were analyzed with Chi-squared goodness-of-fit tests performed on the row totals (Lehner, 1979).

RESULTS

The rut began prior to actual data collection and copulations were observed between the male and three of the females: the subordinate (October 28), and the two subadults (November 5 and 7). Copulation between the male and the dominant female was not observed, but all four females gave birth to kids in 1984.

(See Figure 2.)

Overall enclosure utilization data (Fig. 2) showed a significant pattern (X2 goodness of fit on row totals, df 2 =1,046, p< 0.01). The overall frequency of use was highest for cell 2C, followed by cells 1C and 1B. Further analysis showed that each group used the enclosure selectively (see Fig. 2). The adult male spent most of his time in the upper end of the enclosure (X2, df 2=499.9, p< 0.01). The dominant female and her family spent significantly more of their time in the middle row of cells (X2, df 2=753, p< 0.01), while the subordinate and her kid were most often in the same three cells as the male (X2, df 2=228, p< 0.01). All of the animals avoided the row of cells that was both lowest in elevation and nearest to the public;

thus, it was not possible to determine which variable was responsible for the underutilization of those areas.

(See Figure 3.)

The activity budgets are presented in Figure 3. Overall, the animals spent the greatest percentage of intervals in stationary behaviors (PASSIVE and REST), with FEED/FORAGE and MOVE the next most frequent behaviors observed. OBJECT INVESTIGATION, SOCIAL behavior, MAINTENANCE and PLAY were recorded infrequently. The proportions of time spent in each major activity by the four age/sex classes are also shown. The adult male engaged in social behavior during 11% of the observations, as compared to 1-3% for the other age/sex classes. He also spent relatively more time standing alert and less time in object investigation and forage/feed than did the other chamois. The subadult females and kids spent relatively more time in object investigation; play was observed rarely and only between the kids.

(See Table 1.)

The nearest neighbor data were strongly skewed, illustrating the basic tendency of chamois to maintain interindividual distances greater than 2 body lengths (Table 1). The data also showed consistent, nonrandom patterns of association among group members. Among the females and offspring, these patterns could be predicted by knowledge of kinship and dominance relations within the group. Related animals were nearest neighbors consistently more often than were nonrelated (Table 1). Although the bond between the dominant female and her young weakened as they grew older, the dominant female and her oldest daughter associated more often with each other than either did with the subordinate female.

Details of the adult male's social interactions were obtained from the tally data. Overall, the adult male interacted most with the keepers, followed by the subordinate female and the dominant subadult female. However, the differences between the subordinate female and both subadults were slight. The dominant female ranked last in all categories of interaction with the male (Fig. 4).

(See Figure 4.)

Although there were no serious aggressive episodes during the period of the study, the tally data show that the foci of the male's sexual/aggressive behavior were the keepers (38%), the subordinate female (16%) and the oldest subadult female (16%). At the first sound or sight of one of the two regular keepers, the male approached and began to display in a manner described as characteristic of an adult male challenging another (Knaus & Schroder, 1960; Kramer, 1969). Approaches, bleats, marks and lateral threats were directed to the keepers more frequently than to the other chamois, and the body shake or "slow shake," a display which serves to impregnate the flanks of a male with urine, was exhibited in response to the keepers 90% of the time.

The responses of both adult females were prompt, generally consistent, and often served to terminate an interaction. The dominant female was either supplanted or squatted and urinated when approached by the male; she avoided infrequently. She also approached and presented to the male the least. The subordinate female, who was the focus of the male's sexual/aggressive attention as frequently as was the subadult female, clearly signaled her submission when the male oriented to or approached her--she lowered her head, presented, squatted and urinated, and/or avoided. In contrast, the oldest subadult female displayed submissive or sexual behaviors less frequently than did the subordinate female, and perhaps as a result, the interactions between the adult male and the subadult female were generally longer than those with the other females. The figure shows that the subordinate subadult female received the most sexual attention from the male. This is due to the fact that the only breeding included in the data was with her. However, she also presented to and sniffed the male more than the other females.

(See Figure 5.)

Figure 5 shows the weekly pattern of interactions initiated by the male. This demonstrates the degree to which the male attended to the keepers, and the fact that his orientation to them generally increased until the final two weeks.

DISCUSSION

The most preferred areas in the enclosure, 1B and 2C, contained favored spots for resting. Both were elevated well above the public and offered the animals a good vantage over the exhibit. The area in 2C was also protected from unseen approach. Area 1C contained the barn, which provided food, water, salt and shelter. The top row of cells, used most often by the male, allowed him to remain above the females and kids nearly all of the time. Vantage points in that area also provided the male ample warning of the keepers' approach.

The finding that the chamois spent more time stationary than in forage/feed was expected, due to the feeding schedule employed. The animals were out of sight when they entered the barn for the main feeding of the day, so that activity, which might be expected to provoke some competition, is not represented in the data at all. However, it is somewhat surprising that more of their time was not spent in social interactions, as both Altmann (1956) and Kramer (1969) described them as "highly social" animals. In part this may be due to sampling bias, as behaviors of short duration are underestimated in instantaneous samples collected at long intervals. Some of the most common social interactions among the females were brief. However, that does not account completely for the difference, as the male not only socialized for longer periods, but interacted with the females more frequently than they interacted with him or with each other. The adult male also was the only animal to interact with the keepers. It is likely that what Altmann (1956) and Kramer (1969) referred to was simply the tendency for chamois to group together, rather than to a high rate of social interaction within groups.

The pattern of association revealed in this study by the nearest neighbor identities and distances is consistent with data from several other species in which female kin groups are stable social units (Clutton-Brock, Guinness & Albon, 1982; Fraser, 1968; Moss, 1982). Yet, both Kramer (1969) and Chadwick (1983) found no evidence of any long-term association between related chamois or Rocky Mountain goats beyond the first year of life. It is possible that the pattern we observed is an artifact of captivity. However, it is equally possible that the methods employed by Kramer (1969) and Chadwick (1983) were not optimal for the discovery of subtle social bonds among related females. Further longitudinal work is needed on rupicaprini groups in which kinship is known.

The interactions of the adult male and oldest subadult female were of interest because of the juvenile-like responses of the female. Although it is apparently common for males to attain sexual maturity before they become behaviorally mature and establish a stable social position (Moss, 1982; Strum, pers. comm.), it is not usually described among females. If it does occur, however, the information conveyed by the female's hormonal state would conflict with her juvenile behavior, and might provoke aggression by the male. Alternatively, the behavior patterns of the subadult female may have more closely approximated those of wild chamois, in which the male reportedly chases and herds the females (Hediger, 1968). In that case, the behavior of the two adult females could be seen as the result of habituation due to long association with a single male.

CONCLUSIONS

On the basis of these preliminary results, we have concluded that:

1) Chamois avoid open areas in the middle of their enclosure in favor of those areas with a vertical component. Although this might be predicted from knowledge of the chamois' ecological niche, it was not possible to evaluate the separate effects of distance from the public and elevation, as those two variables were confounded in this study.

2) Although chamois are gregarious, as reported, unrelated animals generally maintain interindividual distances of 2 m or more when at rest. Thus, spacious enclosures may be necessary for stable herd relations.

3) Contrary to the reports that mother-offspring bonds do not persist beyond the first year, the dominant female and all her young were nearest neighbors with one another more often than with non-relatives. Therefore, herds composed of two or more matrilines, with several individuals per kin group, may be more stable than a herd composed primarily of unrelated females.

4) The adult male interacted most with the female keepers, but directed to them behaviors described as typical of male-male competition and/or female defense. The male was most aggressive during this period to the more familiar keeper.

5) If seasonal hormonal changes alter the adult male's behavior regardless of the presence of other males, as appears to be the case (Clutton-Brock et al, 1982), then we would suggest that aggression by the male to a familiar "opponent" serves a useful function for captive males during the rut, as it may reduce aggression that might otherwise be directed to other herd members.

6) Wherever possible, we would recommend the establishment of two separate, but adjacent herds, each with a single adult male. Males could interact competitively with each other through fencing, and could be exchanged between herds periodically to minimize any deleterious effects of inbreeding (Ralls et al, 1979). However, observations of such herds would be necessary to determine whether the presence of another male reduced or exacerbated aggression towards females.

ACKNOWLEDGMENTS

The authors would like to acknowledge the many people who helped us during the course of this research. First of all, many thanks go to the Los Angeles Zoo keepers, R. Barnes, D. Gilchrist and J. Muro, who originally requested the study and were most helpful throughout. M. Crotty, Curator of mammals, also gave freely of his time and knowledge. The late Dr. M. Altmann and Dr. V. Geist suggested the best sources of literature on chamois, and A. Aebi kindly donated time to translate some of that material. Very special thanks go to Michele Mallen and Karalyn Lucci, who donated their time and considerable talents to produce the maps and graphs. Finally, to those who stood in the rain and strained to hear every bleat--R. Fischer, C. Granholm, J. O'Hagen and A. Parsell--we thank you all. This research was supported by National Museum Act grant # FC306860 awarded to the Greater Los Angeles Zoo Association.

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TABLE 1

NEAREST NEIGHBOR FREQUENCY AND DISTANCE

Each entry in the top line represents the overall percent of intervals observed in which animal "A" was nearest neighbor to "B" and "B" was nearest neighbor to "A." The bottom line gives the code for the median distance maintained by each dyad when they were nearest neighbors. Numbers in boldface indicate related dyads.

	AM	DF	SF	DSAF	SSAF	FK	MK
AM	--	9.8	16.2	24.0	16.8	17.3	15.9%
		3	4	**3**	**3**	**4**	**4**
DF	--	--	3.4	15.5	21.7	2.6	52.0%
			4	**3**	**2**	3	**1**
SF	--	--	--	9.3	7.2	64.5	4.0%
				3	3	**1**	3
DSAF	--	--	--	--	30.7	10.2	8.0%
					3	3	**3**
SSAF	--	--	--	--	--	10.4	12.1%
						3	**2**
FK	--	--	--	--	--	--	9.0%
							2

Identification codes. AM=Adult male; DF=Dominant Adult Female; SF=Subordinate Adult Female; DSAF=Dominant Subadult Female; SSAF=Subordinate Subadult Female; FK=Female Kid; MK=Male Kid. **Distance codes.** 0=Contact; 1=>0-1 body length; 2=>1-2 body lengths; 3=>2-4 body lengths; 4=>4 body lengths.

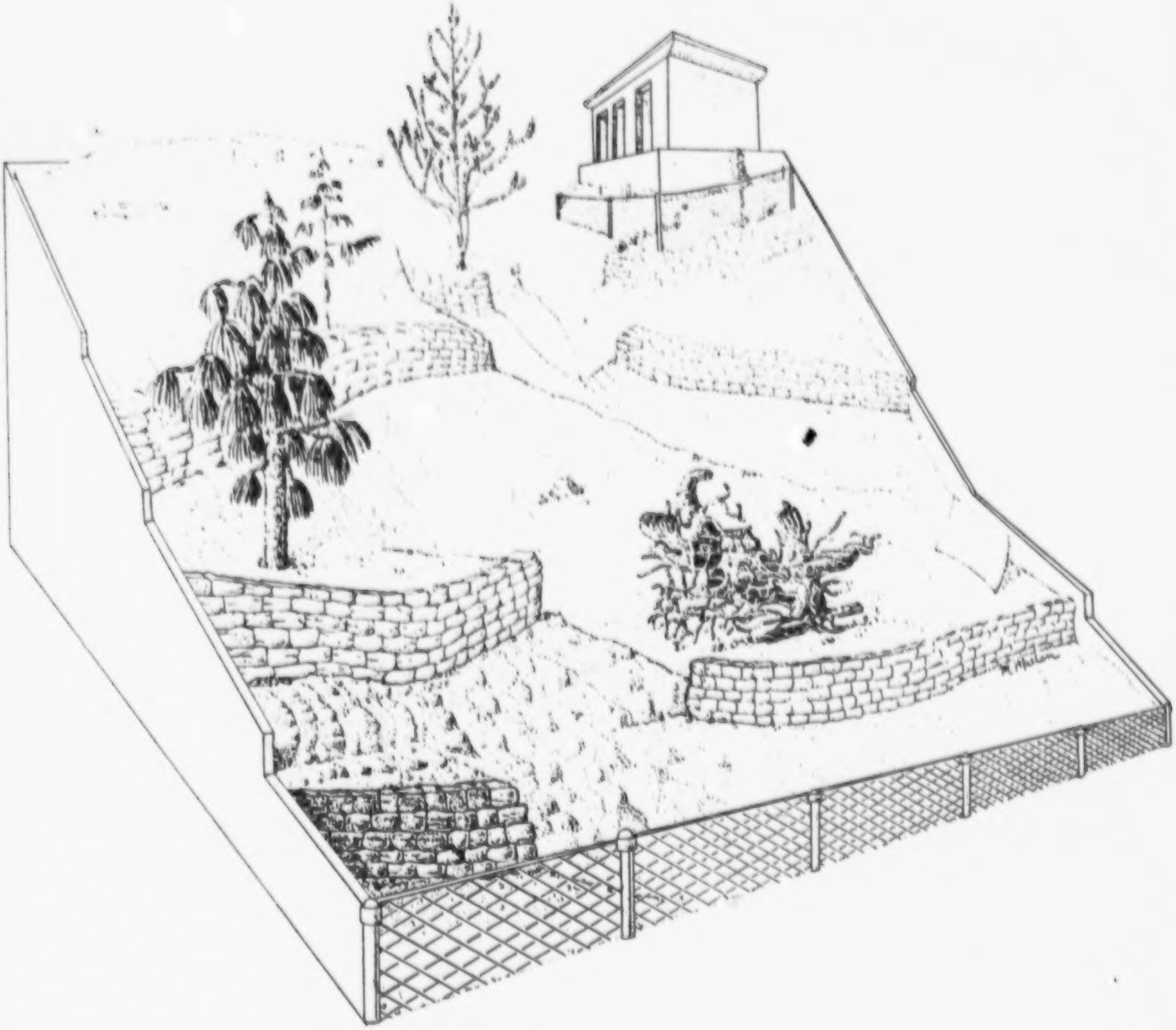

FIGURE 1. MAP OF THE CHAMOIS ENCLOSURE AT THE LOS ANGELES ZOO.

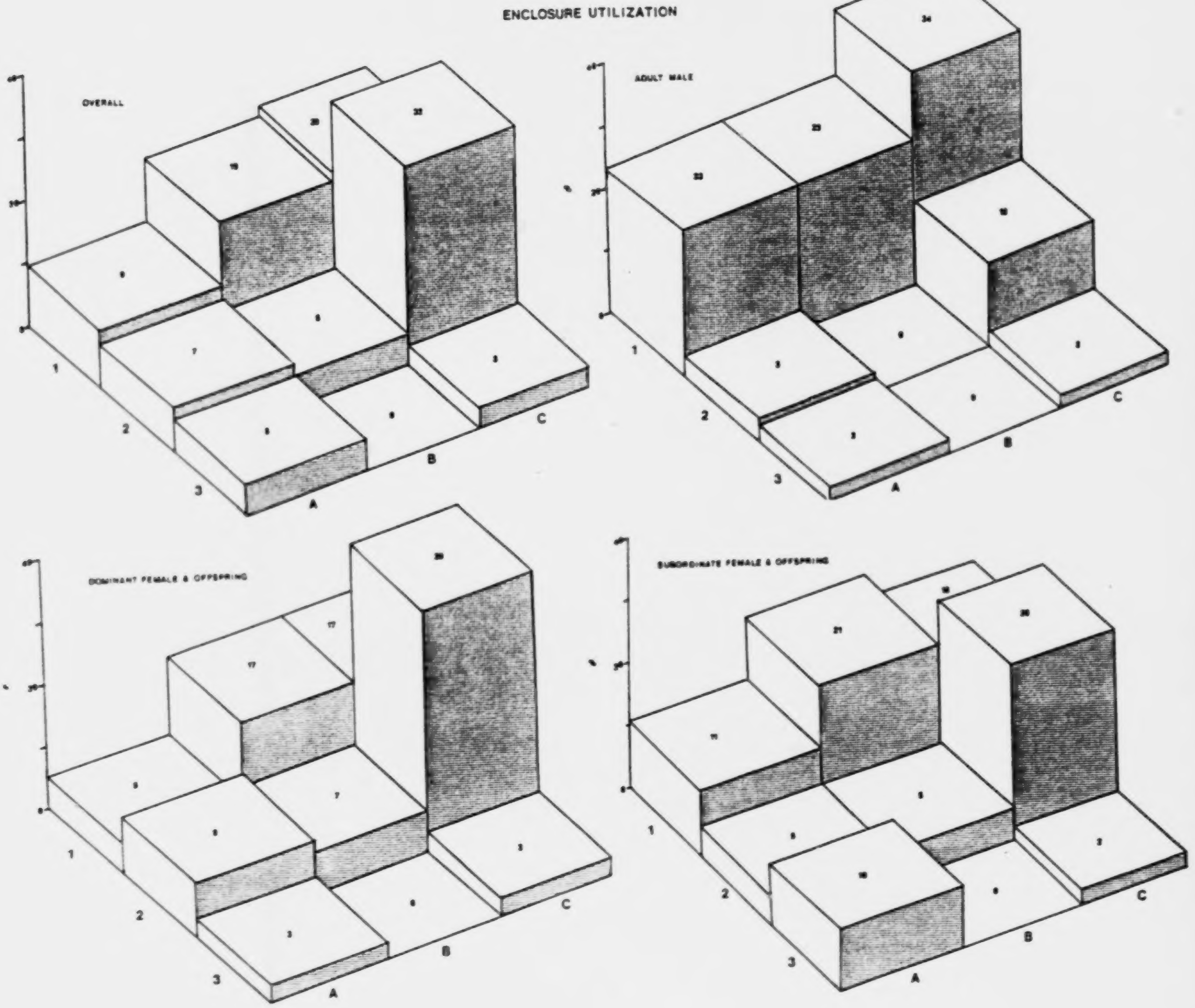

FIGURE 2. ENCLOSURE UTILIZATION. Results are presented as percents of intervals observed. The map quadrats were numbered from left to right as follows: Top row: 1A, 1B, 1C; Middle row: 2A, 2B, 2C; Bottom row: 3A, 3B, 3C.

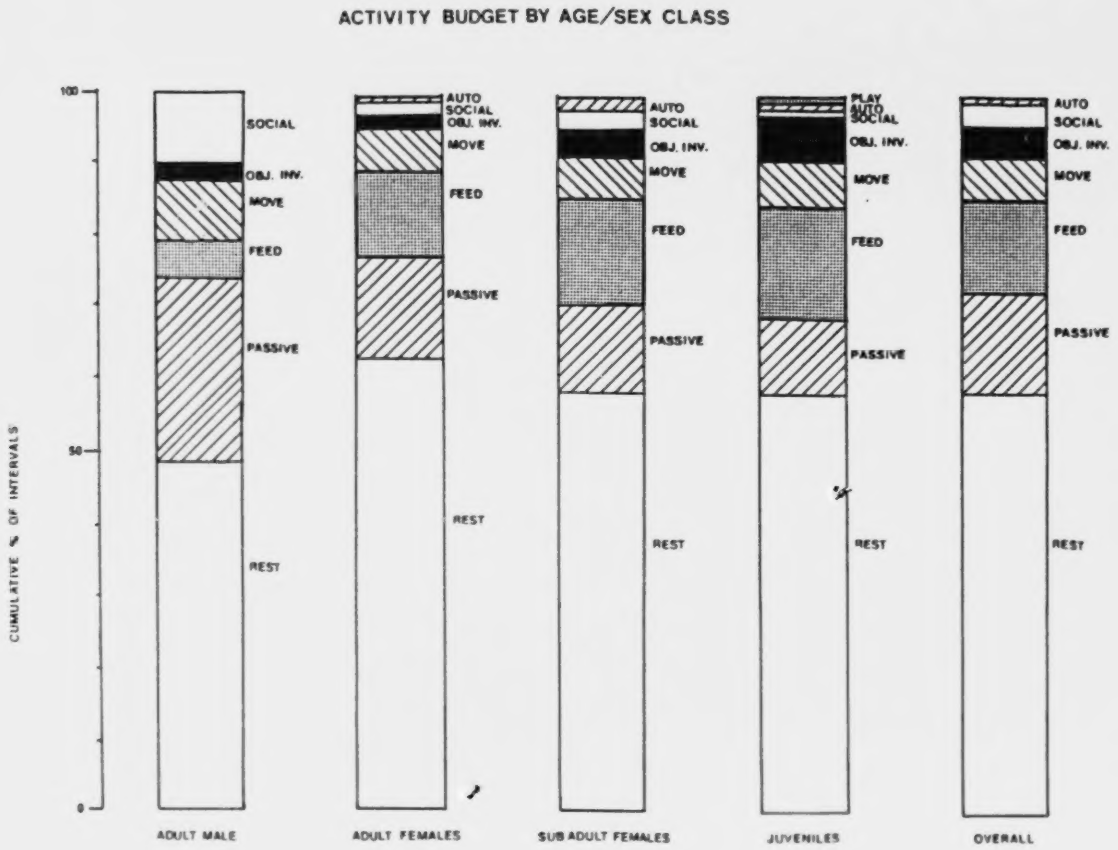

FIGURE 3. ACTIVITY BUDGETS. Results are presented for each age/sex class and for the group overall as cumulative percents of intervals observed.

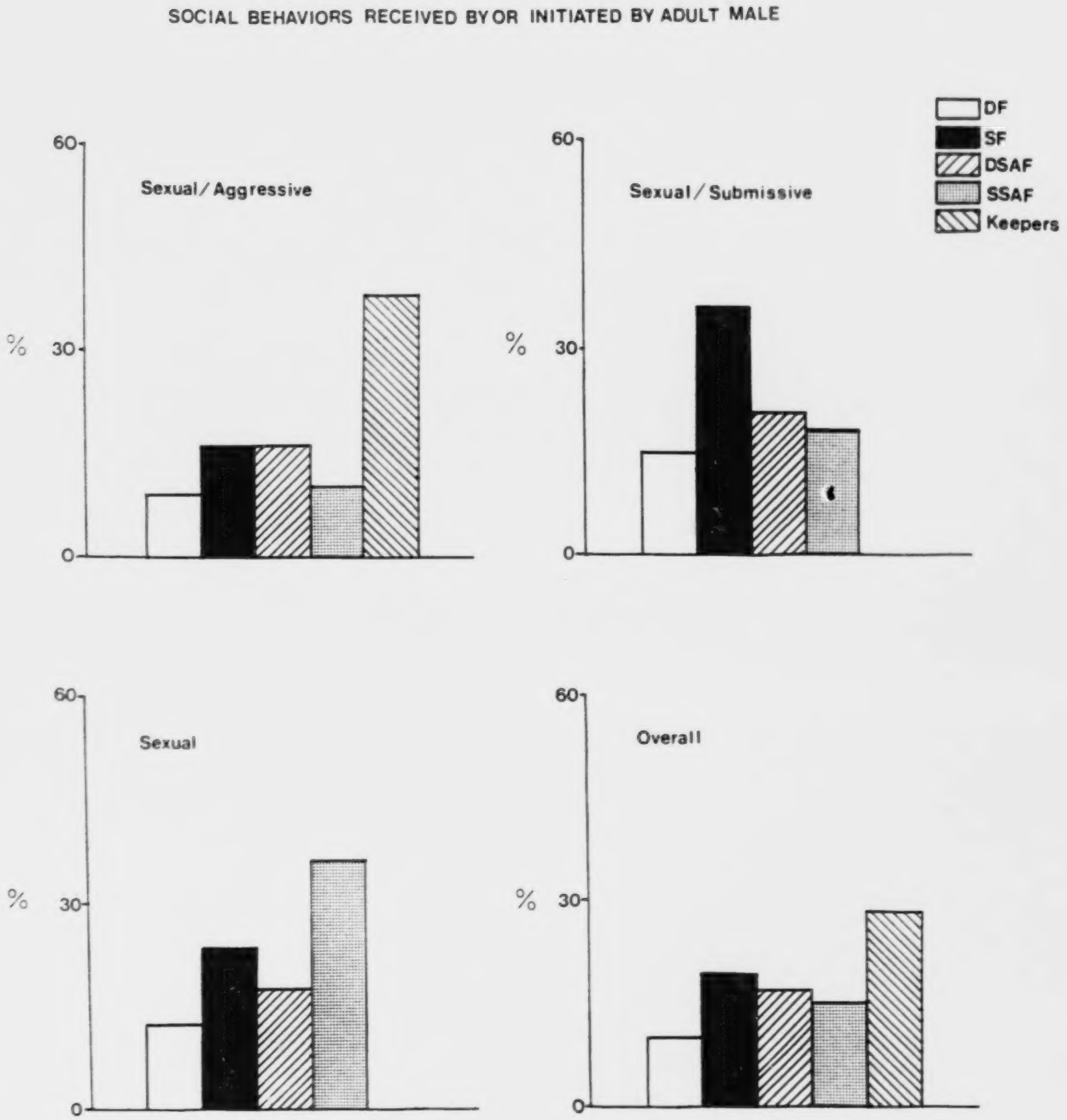

FIGURE 4. SOCIAL BEHAVIORS RECEIVED OR INITIATED BY THE ADULT MALE.

Top left: Sexual/Aggressive Behaviors.
Top right: Sexual/Submissive Behaviors.
Bottom left: Sexual Behaviors.
Bottom right: Overall Social Behaviors.

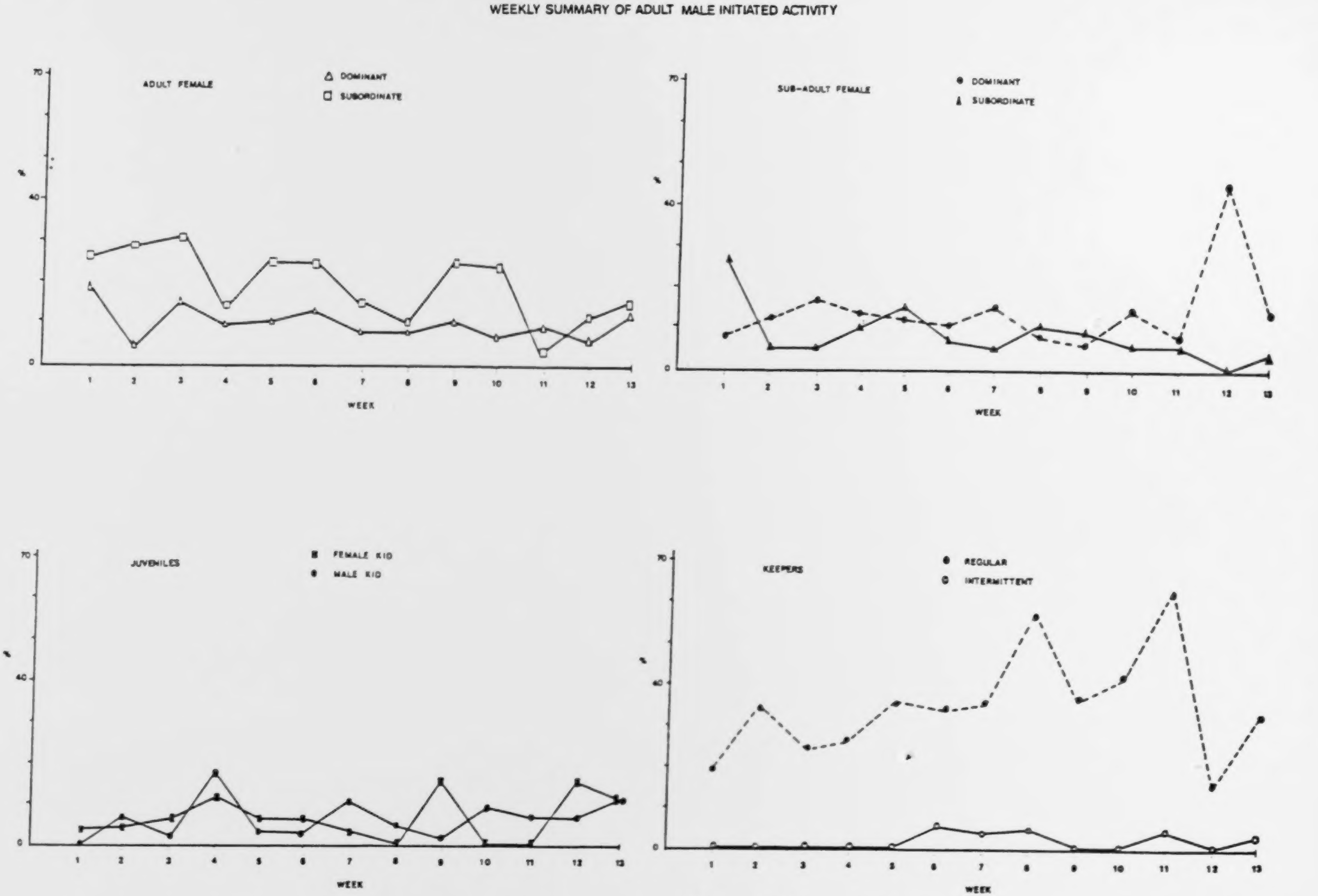

FIGURE 5. WEEKLY SUMMARY OF ADULT MALE INITIATED ACTIVITY. Results are presented across weeks as percent of total interactions.

Top left: Interactions with adult females.
Top right: Interactions with subadult females.
Bottom left: Interactions with juveniles.
Bottom right: Interactions with keepers.

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The Management and Husbandry of the Western Tarsier (Tarsius bancanus) at the National Zoological Park

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Introduction

Tarsiers belong to a category of animals known as the Not Really Rare, Semi-charismatic Microvertebrates. As such they are pretty well ignored by most of the zoo world except those who while away their leisure hours flipping through their *Mammals of the World* drooling over the pictures. For those of you who haven't been reviewing the tarsier section lately here's a bit of background about tarsiers to get you into the mood.

There are three species of tarsiers: *Tarsius syrichta* from Mindanao, *Tarsius spectrum* from Suluwesi and *Tarsius bancanus* from Borneo. Until fairly recent geological times, tarsiers were widely distributed throughout the northern hemisphere. Today, they have a relict distribution only on these few islands. While each species is not uncommon on its native island they should be considered "vulnerable" in their restricted and insular distributions in regions where there is considerable habitat destruction and alteration.

All three species are found mainly in secondary tropical rain forests where the canopy rarely exceeds 15 meters. Occasionally they occur near the fringes of primary forests in low lying coastal areas. They appear to prefer regenerating disturbed areas possibly because of the high incidence of preferred food items in these transitional or ecotonal areas (Fogden, 1974; Niemitz, 1979b; MacKinnon and MacKinnon, 1980). They are all small, about 130 grams, and arboreal. They are allegedly monogamous and territorial with home ranges of up to 2-3 hectares.

Tarsiers are unique among primates in being exclusively carnivorous. Approximately 90% of the diet consists of large, dispersed insects such as beetles, locusts, cicadas and cockroaches while the remaining 10% consists of small vertebrates such as lizards, tree frogs and small birds (Niemitz, 1979a).

Tarsiers are also among the small minority of primates that are nocturnal. They have huge eyes that enable them to see small prey items at a considerable distances at very low light levels. In this series of slides we can see the size of the eyes and the enormous dilation of the iris in a living animal as well as the proportion of the skull devoted to housing the eye. Comparison of the tarsiers eyes with those of the bushbaby and slow loris, two other nocturnal specialists, emphasizes just how extraordinarily well adapted tarsiers are for nocturnal living.

Tarsiers are technically considered "vertical clingers and leapers" because of their habit of suspending themselves from vertical branches then leaping horizontally from one vertical substrate to another (Napier and Walker, 1967). Anatomically, tarsiers are superbly adapted for this mode of locomotion. The fingers and toes are long, powerful and enlarged at the end to provide maximum friction for clinging. The base of the tail, which is bare and transversely ridged underneath, is used as a brace for additional support and the long, powerful hind limbs provide the propulsive force for leaps of well over 10′ at a time (Hill, 1953; Cartmill, 1974; Niemitz, 1984b).

The leaping mode of locomotion is quite remarkable in itself. It begins with the head turn of up to 180 degrees in the intended direction of travel. Then comes the push-off with the animal essentially leaping backwards. The upper body twists in the direction of travel and the rest of the body follows until all is aligned in the direction of flight. The landing is made with the hind feet making contact first (Preuschoft, Fritz and Niemitz, 1979). These leaps are remarkably quiet and in the dark these aptly named "ghost monkeys" appear and disappear noislessly as if turned on and off by a switch.

Very little is known of the natural history of this small, elusive, nocturnal, rain forests dwelling primate. Fieldwork is understandably difficult to conduct and new data has come very slowly. There have been very few captive studies because of the shear difficulty of obtaining and establishing these rather delicate animals in captivity Cook, 1939; Lewis, 1939; Whartomn, 1950; Harrisson, 1963; Ulmer, 1963; Schreiber, 1968) Similarly. there have been very few attempts to exhibit tarsiers. We have found records of only 13 attempts to keep tarsiers in zoos since 1850. Currently, only the Skansen Zoo in Sweden and the Frankfurt Zoo have tarsiers visible to the public and there have been none exhibited in the United States for almost 10 years.

Management and Husbandry

In 1983 we had the opportunity to obtain *Tarsius bancanus* from Sabah, Malaysia in collaboration with the Duke Primate Center. Dr. Patricia Wright of DPC mist netted six pairs after a reconnaisance of the trapping area to determine territorial boundaries and movement patterns. Animals were transferred immediately to large wire cages in the field where they were acclimatized for up to two weeks. This provided an opportunity to release a specimen if appeared to not be adjusting to captivity. Previous ventures of this sort have not including acclimatization and a high post-capture mortality has resulted. For the trip to the US, animals were hand carried in the passenger cabin of an airliner in small crates designed to permit regular and frequent feeding and watering. This may have been the most important step in the whole process as the cabins and cargo sections of airliners so cool and dry that these delicate animals may not have survived without being warmed and regularly rehydrated during the trip. We believe that many tarsiers have been lost in transit because of the failure to attent to these two simple but essential details.

Upon reaching the US all tarsiers were alive and the shipment was split with three pairs going to Duke and three pairs to NZP. One male in the NZP contingent was extremely dehydrated and died a day after arrival. This male's mate became depressed and died two weeks after arrival. The remaining two pairs at NZP and the three pairs at Duke settled in well.

The NZP pairs, the subject of this report, are housed in large rooms 5 m long X 4.5 m wide X 5 m high. The branch network, designed to accomodate the animals' acrobatic leaping abilities, consists of tree branches, bamboo poles and wooden dowels arranged at a variety of angles and heights. The animals are given several cardboard nest boxes that could be entered from the bottom or side.

A forced air heating/ventilating/air conditioning system provides essentially constant temperature range of 80-84 degrees and a humidifier, supplimented with thrice daily misting of the cages, maintains the humidity at 60-70%. When the humidity drops below 50% the animals become noticeably uncomfortable, drink frequently and develop flaky patches of skin.

Two 200 watt white incandescent bulbs set on 12:12 light cycle provide the "daytime" illumination. At night, a 20 watt blue incandescent bulb in each enclosure provides a moonlight glow. The "night" begins at about 1530 and ends at 0330. No ultraviolet light is provided.

Ad lib water is provided in a number of ways. Small crocks are dispersed around the rooms but are rarely used unless the animals are really thirsty. A dripper system made from a distilled water bottle provides a constant supply of water in small amounts is used most by the animals. They also lick water adhering to branches from the thrice daily mistings.

Tarsiers only eat live, moving food. We initially offered a wide variety of food items including *Anolis* lizards, giant Hatiian cockroaches, pinkies, chicks, mantids and grasshoppers but virtually from the begining tarsiers show an almost exclusive preference for crickets. Crickets are deficient in a number of essential vitimins and trace minerals and it was therefore necessary to devise a method of supplimenting the tarsiers diet with these vital components. The typical method of dusting crickets with a vitimin/mineral powder works well with dead crickets, which the tarsiers won't eat, but live crickets groom off 50% or more of the suppliment within 30 minutes after application. Dusted crickets are also less palatable to many animals who will selectively eat non-dusted insects. The method we employ is to provide the crickets with an *ad lib* supply of a specially prepared suppliment. When the crickets eat the suppliment they do not incorporate it into their own body tissues but have it in their gut when the tarsiers eat them. The technique seems to have worked as our tarsiers do not appear to have nutritional problems reported by other institutions.

At any given time there are approximately 300 crickets at liberty in each tarsier enclosure. Dead crickets are removed and the stock is replenished every day; over the course of a week we use approximately 1000 crickets per animal. The average food cost including crickets, suppliments, and lizards is about $2.00. per animal per day.

When the tarsiers arrived they, like most wild animals, had parasites. Worming via injection or tubing was too stressful an option to consider and application of the worming medication to crickets was too unreliable. The method we devised is to mix the wormer with a sticky, palitable paste which is then applied, via a tongue depressor, to the fur on the thigh of each animal just before it awakes. Tarsiers are fastidious about cleanliness and immediately lick the annoying paste off during grooming. Parasites, which included tapeworms and roundworms, have not been completely eliminated but are kept at an acceptable subclinical level.

Reproduction

We have had four young born here, two to each surviving pair. All were healthy and vigerous when born, unlike most of those born in other zoos which appear to be weak and lethargic from birth. We attribute our success to good nutrition and the females' ability to exercise and keep their weight and the weight of the fetus within a range that facilitates trouble free gestation and perturition.

Both females lost their first infants. The first died from a fall. Female tarsiers carry their young in their mouth from place to place and "park" them on a branch when they go foraging. At about three weeks of age the kids start to hop around on their own while the mother is away. We suspect that the first infant fell either when dropped by its mother or when making its first unsteady jumps. To prevent this we now place a thick layer of pine shavings on the floor of the enclosure before birth and as long after birth as seems necessary. Pregnant females become very distended and move quite awkwardly so it's easy to tell when they are pregnant and get the shavings in ahead of time.

The second infant was killed by its father. This was quite a shock as we expected at least some degree of paternal assistance in this supposedly monogamous species. Our observations indicated that the male would wait in hiding for the female to park the infant then he'd take off after it and try to pick it up in his mouth. At first we didn't understand his intentions and interpreted his behavior to be normal paternal care - perhaps the male carried the infant as well. But when the infant shrieked and the female took off after him with blood in her eye it was clear that males are not a direct part of the infant rearing scheme. In fact, asa we watched, it became clear that the females didn't even want the males around and would chase them as far away as possible. Part of the problem was that even our large rooms were too small for the male to retreat far enough to suit the female. Subsequently, we modified the facilities so that each pair had access to two adjoining large enclosures separated by a tall narrow opening that the female can guard. Some weeks before the next birth we began separating the male for longer periods until after birth he was continuously separated except for the approximately 1.5 hours a day when someone was observing. This move worked well. The female, upon spotting the male, would chase him vigrously back into his room never allowed him close enough to the infant to be a problem. In retrospect we can now interpret both females' prepartum intolerance as being the begining of an effort to isolate themselves from the males. Interestingly, the second male never attacked either infant but was also chased both before and after birth by the female. Because of his good behavior he was never physically separated from the female after birth and she reared the infant with no difficulty.

As I've mentioned, the female parks the infant when she goes off to forage but maintains close contact with it at other times. Initially, the infant will usually rest accross her lap cradled by her thighs but as it gets older spends more time actually perched on its own right in front of the female, protected by her body. The female spends very little time away from the infant during the first few days, leaving only to feed, drink and defecate. After the first week, she gradually spends more and more time foraging as energy demands of lactation skyrocket. At about three weeks the kid is actively shinnying up and down supports acting like it wants to jump but it doesn't make its first leaps until about 25 days of age. The first leaps are little frog-hops along a horizontal or 30 degree support often directed towards small prey items such as crickets or roaches. When the infant ventures away from the female it's not uncommon for her to retrieve it in her mouth and try to keep it in a spot of her choosing. This becomes a time consuming activity for her as the infant becomes more coordinated, active and headstrong. The first solids are taken at between 45 and 60 days and the last nursing bouts at approximately 65 days. The last time we observed the female to carry the kid was at 49 days which was the first time we saw them sleeping completely apart during the day. The last time they slept together consistently was at about 85 days.

The gestation period of tarisers is approximately 6 months. This is exceptionally long for an animal of this size and may be due to their having an extremely low metabolic rate which drives a slow rate of growth. Our assumptions about metabolic rate come from comparing observed energy intake with that predicted as for an animal of the tarsiers body size. To do this, we observed tarsiers all night long and counted the number of food items they consumed, determined the energy content in similar sized food items by bomb calorimitry and derived a rough estimate of total energy ingested. The following slide shows the calculations that enabled us to estimate that active tarsiers were consuming between 60% and 80% of the energy predicted for resting animals of their body mass. At this point it's too early to tell exactly what's going on but our data suggests energy utilization so much lower than expected that we hypothesize tarsiers to have either a very low metabolic rate or use energy conservation mechanisms such as low rates of activity or torpor to reduce energy expenditure.

Prey Catching Behavior

Answers to the questions about metabolic rate and torpor must await phsiological study. But we do have good evidence that tarsiers use behavioral mechanisms to cut energetic expenditures. For example, prey catching behavior of these tarsiers is energetically very inexpensive. They do not probe about their enclosures like shrews or tamarins but rather have a "sit-and-wait" prey capture strategy. They will cling more or less motionlessly until they see a potential prey. If the prey is close enough the tarsier leaps on it at once pinning the prey to the branch with its hands and immobilizing it with a bite from its specially modified first and second incisors. Usually the tarsier then leaps away to consume the prey somewhere other than where it is caught. We have observed tarsiers to capture prey in three different ways:

1) About 20% of the time they reach out and catch prey as it walks nearby. Using this method, a tarsier remains immobile for a long enough period of time to allow the unsuspecting prey to amble within arm length.

2) About 29% of the time prey are caught by a single jump after the prey came within range. The single jump and reaching capture methods represented situations where prey entered the tarsier's attack zone.

3) The remaining 51% of the time tarsiers captured prey that were located outside the single jump attack zone requiring the tarsier to move closer before making the attack jump. This was almost always with a series of 2-3 short leaps.

Our tarsiers were successful in 88% of 313 observed capture attempts suggesting a very high catching efficiency. Part of the reason for this success rate is that the accuracy of the attack jump seems to be facilitated by the tarsier being able to get quite close to the potential prey before attacking. As you can see from the next slide fully 72% of all catches are from 0.6 m or less and virtually all are from 1.2 m or less. Our data also show that most of the missed catches occured on the floor or from jump distances greater then 1.2 m.

The pattern of prey captures over the 12 hour night cycle for 10 samples illustrates the foraging patterns. In the first hour after lights out approximately 20-45% of the total nightly capture is made. This is followed by 1/2 to 1 hour in which no captures are made as the animals rest and presumably digest Then follows another burst of foraging at a lower rate, then rest as the pattern is repeated throughout the night. We've counted the number of crickets in the enclosure at hourly intervals and are completely satisfied that the capture hiatuses are not due to a reduction in cricket numbers as a result of foraging. It seems that the tarsiers just fill up and go off to digest their rather bulky prey (Roberts and Baker, 1985).

Activity and Space Use

These tarsiers were completely nocturnal. Our detailed records show that our tarsiers moved *a total of less than 30 times* during the "day" in the two years we have had them. The following slide shows the mean number of minutes active per hour from a pooled sample of 8 animal days in which 24 hour watches were performed. The animals were active an average of 15 minutes per hour but were more active in some hours than others. Most of the activity in the first hour after lights out was concerned with prey catching and eating but later activity peaks tended to be involved with non-foraging behaviors such as grooming, scent marking, interactions and patrolling.

One of the more interesting aspects of our research has been in examining just how our tarsiers use substrates and space in their enclosures. It had been suggested that because tarsiers are "vertical clingers and leapers" that they may be restricted to habitats having an abundance of these support types. The available field data did not really support this (Roberts and Cunningham, in press) so we decided to examine space and substrate use in our animals as they are exposed to a variety of substrate angles, diameters and types.

As the following slides show, the tarsiers showed a significant preference for vertical or near vertical substrates (the arrows show the expected rate of use based on abundance of the different substrate types in the enclosures at different heights), the more oblique angles were used significantly less. Tarsiers have a number of structural modifications of the digits that allow them to cling well to vertical and other surfaces. A critical adaptation for perching is the evolution of the tail into a brace providing substantial support for the body exerting a torque force against the branch. Biomechanical evidence suggests that these adaptations work best when animals perched on vertical or near vertical substrates.

The animals also showed a significant preference for the relativley small diameter bamboo poles. The reason for this seems to be that these smaller diameter substrates seem to allow the greatest surface area contact for the friction support system employed by the tarsiers although they are perfectly capable of clinging to much larger diameter substrates. Secondly, the smaller diameter substrates seem to provide the fine tuned control for jumping that facilitate better aim for locomotion and prey capture.

Most surprisingly, we found that each animal had a very marked and significant preference for staying inside a specific height range. This preference was irrespective of the fact that there is an abundance of the preferred angles and substrate types outside of the height ranges. Similarly, prey were abundantly distributed outside of this range. We concluded that the tarsiers were not using these heights because of increased food or substrate availability but rather because they were avoiding the other heights. As a result they spent most of their time within a relatively narrow height band for virtually all activities. The tarsiers probably avoided the floor because of the difficulty of locomotion there and the canopy may have been avoided because there were fewer stable substrates there or because of an innate tendency to avoid exposed areas.

I hope that this brief summary of some of our findings may prove useful to those of you who's "tarsier" section in Mammals of the World is well thumbed. Our experiences at NZP suggest that tarsiers can be maintained successfully in captivity if proper care and attention are given to the few key points I've outlined here. There's no reason to believe that any zoo willing to invest the time and money couldn't maintain tarsiers. I also think there's enough known about space and substrate requirements, activity regimes, social interactions and reproduction to be able to create exciting exhibits that will once again bring this fascinating species to the North American zoo going public.

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OKAPI AND EPULU - A LONG-TERM CONSERVATION PROJECT

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Metrozoo, Miami, Florida

Very few zoo people would be hard pressed to identify this photograph. It is a male okapi, Okapia johnstoni, in captivity. Some of you are quite familiar with this rare "living fossil" of the Giraffidae family.

Due to its rarity and extraordinary appearance, the okapi was a shooin for the "select few" flagship species that have come to symbolize our zoos and aquariums' commitment to wildlife conservation. Actually, it is more accurate to say captive conservation, since up until now we really haven't played a direct role in preserving its wild habitat.

Presently, there are just under 70 okapis in all the world's zoos. No one is certain how many exist in the wild. Ever since its discovery in the mysterious rainforests of the Belgium Congo, the story of the okapi has been one fantastic episode after another of animal captures and shipments. Wide-spread throughout these colorful accounts are frustrating and very tragic experiences that even today pose serious threats to the future survival of this species and the ecosystem within which it evolved.

Most of what we know of the natural history of the okapi centers around Epulu, a small village in the Ituri Forest of northeastern Zaire. Both the animal and this former capture and breeding station share a unique past as well as an uncertain future.

Since the revolutionary period of the early 1960's when all 25 okapis at the station were killed for food, the exportation of okapis out of Epulu has decreased drastically. To better illustrate the significant rold Epulu played in the establishment of okapi groups in zoos, we first need to go back and briefly review the history of okapi in Zaire.

Almost exactly in the center of the map of Africa lies the Ituri Forest, a vast expanse of dense, damp and inhospitable-looking darkness. Here is what many have identified as the heart of Stanley's Dark Continent. This is the typical description one finds in the old adventure novels entitled "The Wonderland of the Eastern Congo," "In Darkest Africa," and, even more dramatic, "Congorilla." Once within the forest, it is not such a foreboding place, but an incredible multitude of sounds, sights and colors. The Ituri Forest is one of the largest forest blocks in eastern Zaire, covering about 60,000 square kilometers of the upper watershed of the Ituri (Aruwimi) River (Hart, 1984). This is an area roughly equivalent in size to the states of Vermont, New Hampshire, and Connecticut combined.

Sir Henry Morton Stanley passed this way over 100 years ago, first as a British journalist in search of Dr. Livingston and then later commissioned by King Leopold II of Belgium. Stanley's expedition in the 1880's was the first documented visit by a European to this remote corner of the world. Largely unchanged from Stanley's time, the Ituri Forest and the Congo Basin are still a primordial paradise with a network of religious missions serving as the only civilized outposts.

The okapis first appearance in print dates back to 1890 when Sir Henry Stanley remarked about a pygmy tribe that knew a word for donkey. The word was "atti," it only ate leaves and could be caught only in camouflaged pits. It is even believed by Sir Harry Johnston, after personal conversation with Stanley, that Stanley and his companions occasionally caught sight of the okapi when they traversed the region of the Congo Forest on the western side of the Semlike River.

The official discovery is credited to Sir Harry Johnston, who, while serving as a British magistrate in Uganda, was able to obtain two complete skins and one skull from a Swedish expatriate stationed in Beni on the eastern border of the Ituri Forest. When these specimens arrived in London in June, 1901, it settled the question as to what the okapi was, not a zebra but a forest relative of the giraffe. Actually, the okapi is more like the earliest members of the giraffe family than its long-necked cousin (Colbert, 1938). Dr. P.L. Sclater, Secretary to the Zoological Society of London, proposed the name of Okapia johnstoni, and Professor E. Ray Lankaster of the Natural History Department of the British Museum, officially confirmed this scientific nomenclature. Okapi (the generic name), being a Latinized approximation of the native name told to Johnston by the pygmies of the Semliki Valley.

In the very early part of this century, other explorers and hunters procured skins and skeletons of the okapi, but none were able to do so without eliciting the help of the resident pygmies. As is still the case today, only these primitive dwarf-like people of the forest were able to capture such a wary and elusive animal. Without the help of the pygmies, the true identity of the okapi might very well have escaped detection by the scientific community for several more decades into the 20th Century.

Of course, after the discovery of the okapi, the race was on to see which zoo would be the first to exhibit a live specimen. The Belgians had the inside track and in 1919, the first okapi exported out of Africa arrived in the Antwerp Zoo. It was a young female that only survived for seven weeks. The first okapi to survive outside of the Belgium Congo for more than a few weeks was a female "Tele," exported in 1928. She lived until 1943 at the Antwerp Zoo, dying of starvation during World War II.

Until Epulu became an organized capture station under the direction of J. de Medina in 1948, not many okapis arrived alive overseas. Before this time the only coordinated okapi capture and shipment operation was located in the town of Buta. From 1927 to 1941, a Belgium Catholic missionary, Brother Joseph Hutsebaut, helped capture and raise at least 15 okapi. His knowledge and expert care of okapis resulted in successful shipments to Antwerp, London and New York. The male that arrived at the Bronx Zoo in 1937 was the first okapi in North America, it survived until 1952.

Other pre-Epulu operations were not so successful. In 1940 and 1941, there were 13 okapis in captivity at Stanleyville (now Kisangani). By early 1942, 11 of the 13 were dead, 5 from parasitic infections, 5 from trauma and 1 during shipment to the United States.

Records of all known okapi captures and shipments are included in the text of this paper. This information was compiled by the former scientific advisor to the Antwerp Zoo, Dr. Agatha Gijzen, and more recently by Dr. Ernst Lang, former director at the Basel Zoo. These charts do not include the hundreds of animals that died in capture pits nor the young babies that died of malnutrition. We will probably never fully comprehend the effect all these mortalities had on the wild population. The flighty nature of the okapi and its low threshold for stress makes it one of the most fragile and challenging species to capture and acclimate for shipment.

Of the almost 200 okapis that have been exported out of Zaire since 1919, only 85 (45 males and 40 females) have survived one year or more in a European or American Zoo. This 43% survival rate is not surprising considering all the disasters, both foreseen and unforeseen, that can befall an okapi during its long journey from the forest to captivity. Besides the trauma of capture, the animal must survive long and rugged truck rides, at least two or three plane changes, abrupt changes in diet and, in the last 15 years, a 90 day government imposed quarantine where the animal must be immobilized three times for blood samples.

The most active period of capture and shipment was between 1948 and 1962. During this time, 57 (30 males and 27 females) okapi were sent out of Epulu capture station to European and American Zoos. Epulu was the okapi capital of the world, having as many as 28 okapi at the station during this period.

Epulu was founded in 1928 by Patrick Putnam, an American anthropologist from Harvard University. While doing field work, he passed through this scenic river crossing, along the trans African route that runs through eastern Zaire. He liked the place so much he decided to stay. He built a large mud mansion and gradually a village grew up around him which was called Camp Putnam. He established a dispensary and a small zoo and guest house to help pay his expenses.

Camp Putnam, or Epulu as it is now called, became a popular stopover for travelers. It was one of the few breaks in the forest where you could get off the road to Kisangani. It became popular enough that a Frenchman built a beautiful hotel there in the early 1950's. By this time, Putnam's small zoo had been taken over by a retired Belgian army officer who fenced in about ten acres of forest along the Epulu River to hold his diverse collection of animals. To finance his animal collecting hobby, he sold okapis to foreign zoos. Not only did he capture okapis, but he set up off-exhibit breeding areas for his animals.

Epulu, under the direction of J. de Medina, was a very efficient and organized station during its heyday in the 1950's. To show just how remarkable a place it was, I will now show you a film clip of a home movie taken at Epulu in the late 1950's. Dr. Ernst Lang, former director of the Basel Zoo, took this film when he was in Epulu to oversee the shipment of okapis to his zoo. The Miami Metrozoo is deeply grateful to Dr. Lang for allowing us to have a copy of this incredible documentary. The original film is 55 minutes long, the 10 minute edited version concentrates on the breeding and maternal behavior of the okapi.

Up until this point, I've painted a somewhat familiar scenario of a rare animal and its diminishing prospects for future survival in the wild. In the short time I have left, I'd like to propose some viable alternatives to armchair analysis and wait-and-see attitudes.

One week from today, the three okapis at Epulu will be flown to a quarantine facility outside of Antwerp, Belgium. This shipment took over one year to arrange and incorporated the concerted efforts of Zairian officials, zoo directors, veterinarians, curators, keepers, attorneys, air cargo managers and one speculative company, Animals In Motion, who risked a bundle of their own money to make it all possible. In purchasing these okapi, we are providing funds for the Zaire Institute for the Conservation of Nature (I.Z.C.N.) to purchase Toyota land cruisers and other equipment for its financially troubled National Park System.

In preparation for this shipment, the animals were blood tested and examined by Dr. Scott Citino of the Miami Metrozoo last February. The negative test results were only the first hurdle. Next the physical condition of the animals had to be improved, their diets converted over to commercial food and, finally, acclimation to crates for shipment. Experienced personnel from the Miami Metrozoo and others, formerly of the Basel Zoo, have been working with these animals for the past three months. If all goes well, this will be the first exportation of okapis to Europe since 1977. These two males and one female will become part of the captive world herd of okapis. One male will remain temporarily in Antwerp on breeding loan to both the Antwerp and Rotterdam Zoos. The other pair will go to Cincinnati Zoo, the first wild caught okapi to enter the United States since 1962.

Of the 70 or so okapis presently in captivity, all but four of these were born in a zoo. While this shows we can breed okapis in our institutions, it also means more animals are sharing the same genes. As a consequence, the genetically effective population size is much less than the actual number of animals. Loss of heterozygosity per generation will become a serious problem if the population remains closed. While the European okapi breeding consortium and exchanges with American zoos are encouraging, they are not the long-term solution.

No matter how zoos improve the demographic and genetic management of the captive okapi breeding population, we must have more founder representation. George Rabb has calculated the total founder stock representation for all the okapis in zoos--it comes to only 24. The hopeful addition of three more wild okapis would increase founder stock representation by 12½%. This should have a significant impact on the genetic integrity of the captive gene pool.

With the successful integration of three more okapis into the captive world herd, we stand at the threshold of a much greater challenge. We can and must play a direct role in the conservation of the wild habitats of the animals being bred in captivity. Using the rapport we've developed during negotiations and the credibility we've demonstrated with our husbandry skills, we are not in a position to do much more than just import animals for our zoos.

Sitting before the Ministers of Parliament, the Executive Council and President Mobutu, is a contract of assistance to redevelop Epulu into a conservation and nature center. The text of this agreement specifically calls for Epulu to become a training and research center for both Zairian and foreign students, keepers and field biologists.

As you have seen from the film, Epulu is an incredible place, a looking glass into the dynamics of the forest community. It is estimated that about 75% of the Ituri area is still under primary forest cover, and contains substantial populations of large mammals (Hart, 1984). Thirteen diurnal primates and over 12 species of ungulates occur in this area. By providing our experienced zoo personnel, combined with qualified zoologists and botanists, we offer the government of Zaire one of the few resources it lacks, educated and well-trained personnel.

A regulated number of okapi and other indigenous wildlife will be maintained in a semi-captive environment at Epulu in order to carry out behavioral and nutritional studies. Based on my personal experience and inquiries at Epulu, young animals, including okapis, are still brought into Epulu by native hunters. Most of these animals die from malnutrition or inadequate care. A better equipped and more efficiently managed Epulu will prevent this unnecessary situation. Surplus offspring produced from these animals can then be used to revitalize foreign collections without drawing further from the wild. If more okapi come out of Epulu as a result of this redevelopment project, zoos will still have to buy them. Their money will be deposited directly into a special Epulu Fund Account in Citibank, New York. All of the funds generated from the sale of captive-bred offspring at Epulu will be used exclusively to operate and expand the Epulu Conservation and Research Center.

Maintaining breeding groups of representative species at Epulu will also offer the field biologists a control group of valuable baseline data to compare with free ranging conspecifics. This is especially helpful when studying elusive and primarily nocturnal animals in a dense rainforest.

Starting this October, a zoologist and botanist from Michigan State University, Drs. John and Terese Hart, will begin their two-year study on the status, biology and conservation of the okapi in the Ituri Forest. They are being funded by the Wildlife Conservation International Division of the New York Zoological Society. Having previously lived and worked in this region, they are exceptionally qualified to undertake such a formidable task. Collaboration with them has already been mutually beneficial, and together we hope to better assess the effects of hunting, capturing and deforestation on the local animal and human populations.

The Epulu Center is presently being directed by a Swiss couple, Rosemarie and Karl Ruf. They have lived in Zaire since 1979, directing the operations of a zoo in northern Zaire. Prior to this, Karl Ruf was a mammal keeper at the Basel Zoo for 10 years. They, too, are an exceptionally gifted team who understand and care about the people of Zaire. The Ruf's position at Epulu is temporary, pending final decision on the long-term project of assistance the Miami Metrozoo has proposed to the Zaire government. Up until this point, the Miami Metrozoo alone has communicated with the appropriate officials in Zaire. If this agreement is signed by President Mobutu, it should then become a group effort. This would be a tremendous opportunity and responsibility for zoos to become involved with, and a heck of a keeper exchange program!

The success of this shipment and the entire Epulu project is based on a clear understanding of the governmental policies and cultural backgrounds of the Zaire people. We went to Zaire to ask for their help and advice, not to tell them what to do. We worked through their channels and acknowledged their concerns as well as our own.

We have a tendency, sometimes, to assume we are the saviors of the third world. Our solutions along with our personnel are the best and most qualified. Other countries resent this "Big Brother" attitude! International projects must be a two-way street and provide the opportunity to include native personnel in all aspects of planning and operation. This is especially important when dealing with okapi, an animal native only to Zaire and considered a national treasure.

Zoos are entering a new phase of conservation, one that is directly related to preserving the wild habitats of the animals in our charge. The handful of reintroduction projects we have been able to initiate are a step in the right direction. Unfortunately, waiting until one minute before midnight limits the scope of these projects. We can't afford to bask in our temporary "captive breeding" accomplishments. To remain at this point in our development would be a serious and short-sighted mistake.

We would only be marching in place if we continue to do what we have in the past--drain the wild, breed in captivity and delude the public with our cosmetic promises of reintroduction at a future date. For the anticipated descendant of the three okapi about to enter the captive herd, there will be no wild left if we don't take a more international role in conservation. Already one 5,000 square kilometer tract in the southeastern portion of the Ituri Forest has been sold to a logging concession.

For Epulu and the rest of the Ituri watershed, NOW is the time to develop safeguards--to study the wildlife, to train personnel, increase public awareness and ultimately set up a national reserve. Zoos can play a vital role in this process.

To some, this may appear too formidable or impractical, others may feel we are not qualified nor properly equipped to undertake such complex endeavors outside the confines of our own zoos. I don't think we have a choice, unless we are willing to accept a world of only zoo animals. Then what message do our zoological museums convey to the public?

In this case, we are fortunate to have what George Rabb has termed a "charismatic megavertebrate" like the okapi to address our concerns to the public and instill in our own organizations a more realistic ethic of global conservation.

Epulu is the ideal place to develop a long-term assistance program between the Republic of Zaire and our fine zoological institutions. It is these types of projects that will bring us a step closer to our ultimate goal--conservation of the wild.

Exports from Epulu

1948	4.0
1949	2.2
1950	0.1
1954	2.0
1955	4.2
1956	6.6
1957	2.2
1958	0.2
1959	1.1
1960	2.4
1961	4.4
1962	1.1
1973	2.1
1977	0.1

Above table taken from article by Dr. Ernst Lang in International Zoo News, No. 151, 1978.

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ZOO	No.	NAME	SEX	DATE OF ARRIVAL OR DATE OF BIRTH	DATE OF DEATH
ANTWERP	1	Buta	♀	9 AUG. 1919	29 SEPT. 1919
LONDON	2		♂	15 MAY 1928	28 MAY 1928
ANTWERP	3	Tele	♀	15 SEPT 1928	25 OCT. 1943
ANTWERP	4	Kitoke	♂	19 AUG. 1931	26 SEPT. 1931
ANTWERP	5	Kadanga	♂	17 AUG. 1932	25 SEPT. 1932
LONDON	6	Congo	♂	31 JULY 1935	4 NOV. 1935
ROME	7		?	31 JULY 1935	24 AUG. 1935
ANTWERP	8	Roubi	♂	20 JULY 1937	4 MAR. 1941
LONDON	9	Buta	♂	21 JULY 1937	23 JAN. 1950
NEW YORK	10	Congo	♂	3 AUG. 1937	5 SEPT. 1952
PARIS	11		♂	6 AUG. 1939	6 AUG. 1939
STANLEYVILLE	12	Epulu	♀		25 JULY 1941
U.S.A.	13	Kiana	♂		JULY 1941
STANLEYVILLE	14	Niota	♀	8 MAY 1941	
STANLEYVILLE	15	Mahowa II	♀		10 AUG. 1941
STANLEYVILLE	16	Malota	♀	19 DEC. 1940	26 JUNE 1939
STANLEYVILLE	17	Gombari	♀	4 MAR. 1941	8 JULY 1939
STANLEYVILLE	18	Kitoke	♂	24 JULY 1941	21 AUG. 1939
STANLEYVILLE	19	Bibi	♀	22 DEC. 1940	25 DEC. 1939
STANLEYVILLE	20	Matari	♂		
STANLEYVILLE	21	Licho I	♂		30 MAY 1940
STANLEYVILLE	22			1940?	1940?
STANLEYVILLE	23	Malo	♂		30 DEC. 1940
STANLEYVILLE	24	Lorraine	♀	19 APRIL 1941	31 AUG. 1941
STANLEYVILLE	25			8 MAY 1941	
LEOPOLDVILLE	26	Turi	♀	OCT 1947	18 DEC. 1947
LEOPOLDVILLE	27	Ebiane	♂	14 JULY 1947	15 AUG. 1947
LEOPOLDVILLE	28	Ekbate	♂	14 JULY 1947	12 FEB. 1947
LEOPOLDVILLE	29	Etengwa	♂	14 JULY 1947	29 JULY 1947
ANTWERP	30	Eesobe	♂	28 MAY 1948	22 JULY 1958
LEOPOLDVILLE	31	Eboro	♂	14 JULY 1947	31 JULY 1947
COPENHAGEN	32	Essayo	♂	30 APR. 1948	
LEOPOLDVILLE	33	Epulu	♀	OCT. 1947	
LONDON	34	Ekate	♀	28 MAY 1948	29 MAY 1948
PARIS	35	Embo Dolo	♂	2 JUNE 1948	

ZOO	No.	NAME	SEX	DATE OF ARRIVAL OR DATE OF BIRTH	DATE OF DEATH
LEOPOLDVILLE	36	Endulu	♀	OCT. 1947	30 JUNE 1948
STANLEYVILLE	37	Epine	♀	OCT. 1947	5 NOV. 1947
LEOPOLDVILLE	38	Efini	♂	OCT. 1947	17 NOV. 1947
AMSTERDAM	39	Bakumu	♀	11 MAY 1949	23 MAY 1949
ANTWERP	40	Basegela	♀	29 SEPT.1950	
LEOPOLDVILLE	41	Bedami	♂	11 MAY 1949	14 JUNE 1949
LEOPOLDVILLE	42	Biangu	♂	JUNE 1949	18 OCT. 1949
BASEL	43	Bambe	♂	16 JUNE 1949	21 AUG. 1949
ANTWERP-LONDON	44	Zendy	♀	16 JUNE 1949	15 SEPT. 1952
STANLEYVILLE	45	Barambi	♂	NOV. 1948	
LEOPOLDVILLE	46	Bomili	♀	11 MAY 1949	30 JULY 1950
NEW YORK	47	Beni	♂	15 JUNE 1949	
LONDON	48	Butembo	♂		27 MAY 1949
LEOPOLDVILLE	49	Bunia	♂	11 MAY 1949	12 MAY 1949
LEOPOLDVILLE	50	Bukaou	♂	11 MAY 1949	14 JUNE 1949
LEOPOLDVILLE	51	Andudu	♂	7 AUG. 1954	14 JAN. 1955
EPULU STATION	52	Nepoko	♂		
EPULU STATION	53	Mandzombo	♀		
EPULU STATION	54	Bimoya	♀		
EPULU STATION	55	Mambasa	♀		MAR. 1954
EPULU STATION	56	Epini	♀		
EPULU STATION	57	Louis	♂		OCT. 1953
FRANKFURT	58	Costy	♀	14 MAY 1954	
EPULU STATION	59	Ebiane	♀		OCT. 1956
EPULU STATION	60	Mambasa	♀		
EPULU STATION	61	Elisabeth	♀		
EPULU STATION	62	Mankini	♀		31 MAR. 1954
EPULU STATION	63	Angombe	♀	14 FEB. 1954	30 SEPT. 1953
EPULU STATION	64	Makwamu	♀	10 OCT. 1953	
ANTWERP	65	Hoka	♂	18 SEPT.1954	19 SEPT. 1954
ANTWERP	66	Isangani	♀	30 JUNE 1955	
LISBON	67	Gangala	♂	27 JUNE 1955	
SAN DIEGO	68	Bayahu	♂	27 NOV. 1956	
PARIS	69	Irumu	♀	11 AUG. 1955	
EPULU STATION	70	Kama	♂		31 MAR. 1954

ZOO	No.	NAME	SEX	DATE OF ARRIVAL OR DATE OF BIRTH	DATE OF DEATH
CHICAGO	71	Aribi	♂	10 AUG. 1955	
EPULU STATION	72		♂		25 MAY 1954
BASEL	73	Nanou	♂	22 SEPT. 1955	
ELISABETHVILLE	74	Bamopi	♂		
ANTWERP	75	Imayala	♂	10 AUG. 1955	
-	76	-	♂		
EPULU STATION	77	Koki	♂	15 DEC. 1954	
WASHINGTON	78	Hanadi	♀	26 NOV. 1956	
CHICAGO	79	Adussa	♂		24 JUL. 1955
EPULU STATION	80	Kaichui	♂		
BASEL	81	Vananbo	♂		
BASEL	82	Bahati	♀	19 JUL. 1956	AUG. 1956
EPULU STATION	83	Etongo	♂		15 MAR. 1955
ROME	84	Gwengbata	♂	18 OCT. 1956	18 OCT. 1957
CHICAGO	85	Museka	♀	2 NOV. 1956	
EPULU STATION	86	Yafari	♂		
-	87	Elisa	♀		
COPENHAGEN	88	Claire	♀	2 AUG. 1956	9 AUG. 1956
PRETORIA	89	Andre	♂	26 AUG. 1956	27 JUNE 1957
ST. LOUIS	90	Bunia	♂	26 NOV. 1956	
PRETORIA	91	Babesoa	♀	26 AUG. 1956	25 APRIL 1957
WASHINGTON	92	Masudi	♂	26 NOV. 1956	
EPULU STATION	93	Madona	♀		18 DEC. 1955
EPULU STATION	94	Niania	♀		
EPULU STATION	95	Bandaku	♂		
-	96	?	♂		
EPULU STATION	97	Bandaka	♂	17 JUNE 1956	28 MARCH 1956
AMSTERDAM	98	Manala	♂	2 AUG. 1956	27 DEC. 1956
EPULU STATION	99	Munyonga	♀		15 APRIL 1957
NEW YORK	100	Muyoni	♂	1 NOV. 1956	
ANTWERP	101		♂	3 JULY 1956	3 JULY 1956
-	102	Rachid	♂		
EPULU STATION	103	Zano	♂		23 JUNE 1957
EPULU STATION	104	Amida	♀		
-	105		♂		

ZOO	No.	NAME	SEX	DATE OF ARRIVAL OR DATE OF BIRTH	DATE OF DEATH
EPULU STATION	106	Nyeusi	♀		
EPULU STATION	107	Mamvu	♂		
ROTTERDAM	108	Mambuti	♀	17 APRIL 1957	
EPULU STATION	109	Uruma	♂		
	110	Mbula	♂		
ROTTERDAM	111	Dinota	♂	17 APRIL 1957	
EPULU STATION	112	Bwana	♂	16 OCT. 1956	
BALE	113	Bibi	♀	26 JUNE 1956	
EPULU STATION	114	Muzalia	♂	19 JULY 1956	APRIL 1957
EPULU STATION	115	Matata	♂		1 MAY 1957
EPULU STATION	116	Kuango	♀		
EPULU STATION	117	Penge	♂		
STANLEYVILLE	118	Zamuya	♀	DEC. 1957	
EPULU STATION	119	Makoya	♂		
RIO de JANEIRO	120	Alafu	♂		15 SEPT. 1957
EPULU STATION	121	Keba	♀		
COPENHAGEN	122	Baguya	♀	30 APRIL 1958	
PARIS	123	Ebola	♀	6 JUNE 1957	
STANLEYVILLE	124	Penguma	♂	DEC. 1957	
EPULU STATION	125	Pengituri	♀		
EPULU STATION	126	Makalo	♂		15 AUG. 1957
EPULU STATION	127	Useni	♀		
EPULU STATION	128	Tibiazo	♀		
EPULU STATION	129	Musa	♀	1 AUG. 1957	AUG. 1957
-	130	Mamoya	=		
EPULU STATION	131	Koki	♂		13 DEC. 1957
EPULU STATION	132	Mia	♂		
EPULU STATION	133	Angali	♂		
EPULU STATION	134	Isilamu	♂		
ANTWERP	135	Lipumbe	♀	22 JAN. 1958	4 FEB. 1958

NEW ELEPHANT FACILITIES FOR BREEDING PROGRAM AT THE FORT WORTH ZOO

Dudley Brown, Assistant Director

In September, 1985, the Fort Worth Zoological Park completed construction of a 3.6 acre elephant/hippo exhibit at a cost of $1,250,000.

Funds were provided through a City of Fort Worth capital improvement bond program and through a donation to the city from the Fort Worth Zoological Association.

The goal of this project was to replace a small elephant exhibit built in 1923 with a spacious modern facility suitable for breeding Asiatic elephants for conservation purposes in a safe and humane manner.

During the planning stages, much information was learned from the Washington Park Zoo in Portland, Oregon and the Calgary Zoo in Calgary, Alberta. We wish to thank these zoos for their willingness to share facts and to follow their example by providing information to those who wish to learn from our experience.

Viewing of the elephants is provided across moats at four locations and through acrylic windows at a fifth. Between the moats, 16' telephone poles set 5' deep in concrete were used to expand the perimeter, thus increasing the area of the animal yards within. The moats were situated to provide the viewer with a different "vista" at each location to increase interest.

In the center of the yard, telephone poles were used again to protect two groups of trees by circling them. Spaces were left between the poles to allow the keepers a retreat. Within these two islands, manually operated 4" pipe gates were mounted which when closed, divide the animal area into three yards.

A fourth elephant yard is contiguously located on the south side of the barn designated as the bull pen. Viewing here is through acrylic windows protected by wood poles and steel columns which support a poured concrete roof for shade.

The moats are made of 8" thick, steel reinforced poured concrete. They are ten feet wide, seven feet deep and have a soft earth floor. At the end of each moat is a ramped exit leading through a gate to the yard.

On the elephants' side of the moats, five foot wide concrete cleaning aprons are placed one foot below the top of the moat walk. It is hoped this height difference plus the fact that the moat walls are topped with inverted 3"x3"x1/4" angle iron will discourage elephants from standing on the edge of the moats and will provide traction to reduce accidental bumps of animals into the moats.

On the public side of the moats two foot wide planter beds and three foot tall guard rails further separate the public from the animals.

As the visitor walks from moat to moat, other animal exhibits exist on the opposite side of the sidewalk to view or we have provided planting and graphics to break up the monotony of the long pole walls. The graphics are large and various subjects are covered. One exhibit is a life-size silhouette of "Tusko," apparently the largest male Asiatic elephant measured alive. It stands 10'9" at the shoulder, is made of 3/8" galvanized steel and weighs 2,000 pounds.

There are four pools in this project, the largest being in the main display yard. It measures 70 feet long by 60 feet wide, is five feet deep and contains about 60,000 gallons of water. The second pool is 50 feet long, five feet deep and contains about 45,000 gallons. It is the hippo exhibit pool. The third and fourth pools are indoors for elephant and hippo and are equally sized at four feet deep, 18 feet wide and 20 feet long.

The elephant/hippo barn is 6,912 square feet divided into eight rooms.

The building is heated with two forced air gas fired furnaces and a six zone floor heat system that circulates warm water through 3/4 inch i.d. "Yoloy" pipes placed on two foot centers which are embedded under six inches of concrete on a 2" layer of concrete poured over a two and one-half inch thick piece of "Panel Therm" urethane insulation. It is expected the floor heat will be the primary heat for animal comfort.

The roof contains six skylights totaling 720 square feet which can be propped open to allow summer heat to escape via convection. During other seasons, seven large manually activated electrical ventilators mounted on the roof provide a draft through the animal areas with three smaller units ventilating the mechanical rooms.

The walls of the building are panels of steel reinforced concrete seven and one-fourth inches thick which were poured on the site, erected with a crane on top of deep piers and welded together. A beige color was added over the concrete after it was sandblasted for the external finish after erection. The inside surface of the panels forms the animal enclosure walls and was trowel-finished when poured.

There are sixteen hydraulically operated doors within the barn to facilitate transferring the animals. There are solid doors and pipe doors. The solid doors are formed with channel bar frames reinforced with 5/8" re-bar welded on 12 centers horizontally and vertically and filled seven inches thick. The pipe doors are made with four inch square stock frames with four inch round pipes set vertically on two foot centers for the actual barrier.

At one opening between two rooms we have installed a solid door and a pipe door. This is known as the "date gate" where animals can get acquainted through the pipe door but separated with the solid door if need be.

Each door is powered by a single push-pull hydraulic piston with a 6,500 pound operating force which is activated by an electric push button. When not activated, an intergal valve locks the doors so that if pushed in one direction the force is transferred equally to the other direction resulting in no movement of the door itself.

The door hangers are copied directly from Portland's design utilizing Wilcox hardware. On the bottom of the doors is a 3-1/2" channel bar guide which stratles a 3" channel bar track mounted to a floor plate which holds the door in place.

The largest room in the barn is the "cow parlor." It measures 72' long and 46' wide. Two rows of 4" steel pipes filled with concrete set on 2' centers, placed 8' in from the side walls form two safe keeper service areas. Running the full length of the room in the center is a railroad rail embedded into the concrete to form an anchor line for attachment of front leg chains. Rear leg chains are attached to the vertical pipes along the side keeper service isle.

The concrete floor is finished smooth and slopes at a 3/8" per foot angle to the gutter drains in the keeper isle. Concrete is mounded into the corners to prevent puddles.

One 10'x12' area on the parlor ceiling contains an eight-nozzle shower reminiscent of a car wash. It is supplied with tempered water set at 85°F and is operated with a 0-60 minute timer that activates a solenoid valve thus freeing the keeper from having to return to shut off the shower.

Above the keeper isles on each side of the parlor are two equipment rooms 8' wide and 72' long. All support equipment is located within these areas including the 30 hp electric hydraulic pump motor and control valves, the forced air furnaces, the gas fired floor heat water heater, the shower, water heater, ventilator controls and so forth.

Two elephant passage ways were designed to serve as elephant treatment areas. One measures 8'x13' and one measures 9'x6'. Both have pipe doors, walls and ceilings, the latter to allow attachment of hoists and to provide overhead access. Hydraulic power from nearby door pistons can be transferred through chains and pulleys to facilitate lifting for veterinary work.

The building contains two rooms 27'x19' designed as a bull pen and a quarantine room. These are separated by a "shift" room 19'x16'. The shift room has four doors plus the "date gate." A bull must pass through the shift to go outside or into the cow parlor.

The bull rooms and the shift room have leg chain attachments points poured into the side walls and a railroad rail embedded into the center of the floor for use if need be. Keeper viewing is through slots sawed into the walls. It is satisfying to me to note that the zoo's old elephant barn which housed two elephants would fit within either of the new bull pens with about 20% of the new space left over.

The bull pen designated for quarantine contains an outside door opening onto a loading dock. This dock serves to unload elephants from rear opening trucks directly into the barn at floor height. The loading dock area drains into a sanitary sewer as the zoo's manure truck is normally loaded here. A second loading door is located at one end of the "cow parlor" which will facilitate loading or unloading into the side door of a truck or trailor.

Much attention was given to the design of the sanitary drainage system servicing the building and pools. We hope to have overcome some of our traditional problems by: 1) installing a clean-out at the top of each of four separate straight, 6 inch collector lines; 2) by not installing "p" traps under the drains; and 3) by installing large poured concrete "straw" traps at the end of the lines. Each of the four straw traps contains two 24" diameter by 24" deep stainless steel baskets, placed on two levels within, the deepest being where the sewage enters and is filtered by the basket prior to being lifted up onto a step where the excess water can drain out prior to the basket being lifted out to be emptied.

The bottom of each basket is solid with a solid two inch lip to collect sand.

Also included in this project were a large paved and drained service yard for vehicle storage, a hay barn designed to contain four large truck loads of hay, a room for crate storage, a dry goods storage area and an entrance gate ticket booth and turnstiles.

NEONATAL ARTIODACTYLID CARE AT THE ST. LOUIS ZOOLOGICAL PARK

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The neonatal protocol in current usage at St. Louis includes physical examination of the calf at 24 hours of age unless obvious calf distress dictates earlier attention. Adequate dam-calf bonding appears to have taken place at this stage for calf separation followed by successful reintroduction (Lent, 1971). The examination includes the collection of a blood sample for immunoglobulin evaluation, administration of a vitamin E/Se preparation and repository antibiotics, an earnotch and weighing. Similar protocols have been described (Ensley, 1978)(Mehren, 1981). Species of antelope included in this confined management system are (with number of live births from 1970-85 in parenthesis) addax (9), blesbok (10), eland (35), gerenuk (19), greater kudu (32), impala (56), lesser kudu (33), sable antelope (34), Speke's gazelle (93) and springbok (69). Other artiodactylids treated in the same manner are Rocky Mountain bighorn sheep (5), Stone's sheep (8), banteng (8), gaur (12), reticulated giraffe (10), bactrian camel (7), llama (76) and Rocky Mountain goat (1). Survivability of these species expressed as a percentage of live births attaining 30 days and 6 months of age will be discussed (Table 1). Attention will be given to the survival rates from 1970-79 (prior to the full introduction of these techniques) and 1980-85 (postintroduction).

Dam and calf are separated by the use of shift cages, and the calf is removed to an adjacent area out of maternal sight. Blindfolding helps reduce calf excitability. The calf is weighed for medication dosage and to establish a baseline for future reference. For several species both weight and growth curves have been established and correlated with calf survivability (Templeton, Read, 1984). The calf is given a rapid, yet thorough, physical examination with particular attention given to organ systems that may be affected by congenital defects; e.g., cleft palate, heart defects or atresia ani. If the navel is not dried, it is dipped in a tamed iodine solution.[a] Rectal temperature is taken to evaluate hypothermia. Animals are earnotched for identification.

Blood is collected for a complete blood count (CBC), saving of sera for future reference, and evaluation of neonatal colostral intake. Due to failure of immunoglobulin transfer across the artiodactylid placenta, the calf is dependent on absorption from the gastrointestinal tract of protective antibodies present in colostrum. These proteins are absorbed for only limited periods postpartum (up to 24 hours in cattle, 4 days in goats, 29-48 hours in lambs)(Blood and Henderson, 1974). Exotic ruminants are not well studied in this regard; however, increasing delays in colostrum ingestion will result in decreased absorption. A measure of the critical nature of this protection is the fact that 90% of beef calves with E. coli septicemias failed to ingest or absorb colostrum (McGuire, 1982). Though not a direct measure of immunoglobulins, measurement of dextrose levels in whole blood can be easily accomplished in the field and indicate general nutritional status[b] (Ensley, 1978). Dextrose values of less than 50 mg/dl indicate a need for supplemental feeding and values less than 25 mg/dl indicate marked hypoglycemia frequently associated with hypothermia. Supplementation with 50% dextrose IV at the rate of .5 ml per pound will aid in correction of the hypoglycemia (Koterba, 1983).

The gluteraldehyde test as described in exotic hoofstock (O'Rourke, Satterfield, 1981) has been a convenient and reliable method of testing antibody status. It should be evaluated in each new species by checking sera from control animals, though it may be inconsistent in camelids. Total protein levels and globulin fractions have also been used at St. Louis to confirm the results. In calves not receiving colostrum, attempts have been made to supplement them at 24 hours of age with bovine (dairy) colostrum with variable results. Fifty ml colostrum/kg are recommended for domestic cattle (Radostits, 1980). Failures may be due to poor absorption of the gut at 24 hours and varying interspecific antibodies. At St. Louis it has been felt that the losses from failure to absorb colostrum from administration at 24 hours are outweighed by decreased interference in the dam-calf bond. Though not employed at St. Louis, prolonged feeding of colostrum as a portion of the formula has been shown to be beneficial, presumably due to local (gut) protection by the antibodies (Heuschele, et al., 1984)(Radostits, 1980). After 24 hours protection may be provided by parenteral administration of homologous species plasma (Satterfield, O'Rourke, 1981).

Injectable vitamin E/selenium[c] is administered intramuscularly in efforts to reduce the incidence of nutritional white muscle disease (WMD). Maternal diets at St. Louis consist of a commercial herbivore pellet[d] containing .2 ppm and free choice selenium (3 ppm) salt blocks.[e] However, occasional episodes of WMD have been observed in lesser kudu and gerenuk calves not given additional supplementation. Muscle degeneration may only represent the "tip of the iceberg" as low vitamin E/selenium levels may produce a variety of other syndromes such as stillbirth, infertility and poor growth in domestic animals. Injectable repository antibiotics[f] are also administered in an effort to reduce omphalitis (navel ill) and subsequent septicemia. Episodes of navel ill in greater kudu and springbok appeared to be reduced by this treatment. No side effects from this initial therapy have been noted, though prolonged prophylactic antibiotic therapy in the neonate should be avoided.

After examining the neonate, reintroduction methods vary with the species and have been accomplished with only rare interference in the dam-calf bond. Precocial species such as the blesbok and impala are born into the herd and are separated only for physical examination. On reintroduction they are isolated with their dam (and another herd member in the case of impala) for 30 minutes. Evidence of maternal care, such as the induction of calf urination, is used as a signal for rejoining the herd. Other hider species; e.g., gerenuk and lesser kudu are reintroduced in a 1:1 dam-calf situation for a short period of time and then returned to the herd. The springbok dam and calf differ in that they have been isolated from the herd for the first postpartum day, and after a short reintroduction period with each other, are replaced into the herd. Speke's gazelle dams and calves are not reintroduced into the full herd until approximately 10 days postpartum.

In the event of failure to nurse or maternal neglect, calves are removed from the herd to an isolation stall where they are fed supplemental bottles accompanied by a whistle. Formulas used at St. Louis are listed in the AAZPA Infant Diet Care Handbook (Taylor, Bietz, 1980). Keeper contact is kept to a minimum. A bottle is generally well accepted by 2-3 days, and the calf will cross the stall to the auditory stimulus by 11 days. They are generally reintroduced to the herd at 14 days. Maternal interest may be manifested, and aggression has not been a problem. The calf will leave the herd for feeding and return afterwards, and appears to benefit from the herd's social structure. The females in our present springbok herd were raised in this manner due to maternal neglect and have all become functioning mothers themselves. Springbok, greater kudu, gaur and gerenuk have been raised in this system (Read, 1982). The number of neonatal hoofstock raised in a nursery is greatly reduced, and in our experience, this drastically reduces the transmission of neonatal diarrheas and other infectious diseases.

Calf removal may also be necessary for the administration of intensive veterinary care in the moribund neonate. Such techniques have been described (Ensley, 1978)(Koterba, 1983). Decisions to remove the neonate jointly involve the veterinary and curatorial staffs, taking into consideration the genetic and financial value of the individual, possibility of herd reintroduction, chances of genetic origin of the problem, and sex of the animal, in addition to the severity of the medical condition.

The 507 births in the artiodactylid species discussed were analyzed for 30-day and 6-month survivability in an effort to evaluate the protocol and isolate both improved and problem species (Table 1). Data from individual species and totals are presented from 1970-85, 1970-79 (preprotocol) and 1980-85 (postintroduction). Thirty-day survivability was chosen due to its common usage, and 6 months was arbitrarily chosen due to 1) a desire to ascertain how many animals achieved young adulthood, and 2) a notable lack of neonatal/developmental causes of deaths beyond that period in St. Louis. 77% of all artiodactylid live births survived to 30 days, and 72% to 6 months. (Where different from 30-day figures, 6-month data are presented in parentheses in Table 1.) The results of such pooled data can be confusing; e.g., eland with a 6-month survival rate of 94% are no longer kept at the zoo, while gerenuk with a 63% survivability were added in 1977. In some species few individuals in selected timeframes make comparisons difficult; e.g., gerenuk 1970-79 (4 animals), greater kudu 1980-85 (3 animals). In fact, little difference between the two time periods is evident in the overall summed data; however, individual species variations exist.

A closer analysis of individual species' 6-month survivability displayed some interesting trends that will be discussed briefly. Most notable improvements from the 1970-79 period to the 1980-85 period were in Speke's gazelles (54%-74%) and impala (62%-77%). In the former, controlled management of inbreeding may have contributed to the increased viability of offspring (Templeton, Read, 1984). Additionally, improved pregnancy diagnosis (by improved management practices and the use of ultrasound) led to increased separation of calving females from males and markedly less cagemate trauma to calves. Reasons for the improvement in impala are less clear, but hopefully, are also related to improved neonatal management.

Several problem species are also notable in reviewing the data. Sable antelope viability dropped from 94% to 56% in the second period. This may be due in part to inbreeding. Two recent calves from the same parents have died of a bleeding disorder. The disease is currently being evaluated as to its nature and possible genetic origin. More difficult to explain are the high losses in greater kudu (36% survival) and relative success with lesser kudu (73%). No readily discernible management differences existed; however, a high incidence of navel ill was noted in the greater kudu. Additionally, the greater kudu herd was infected with malignant catarrhal fever (MCF) in 1971 from adjacent wildebeests. The wildebeest herd was removed, but any carrier state in the greater kudu and its effect on their offspring would be difficult to assess at this time. A similar comparison could be made for adjacent enclosures of Rocky Mountain sheep (40%) and of Stone's sheep (88%). No common factor such as pneumonia or lungworm could be associated with the bighorn deaths, and the small bighorn population (5) makes significant conclusions difficult.

Further analysis revealed species variability in the time of deaths--data that may be helpful in the identification of risk and disease factors in the neonatal period. Springbok were typical of most species, 84% of all deaths (of 25 total deaths) occurred at less than one week of age with 16% occurring from one week to 6 months. Gerenuk presented the opposite pattern; 14% (of 7 total deaths) died one week or less, but 86% of deaths occurred from one week to 6 months of age. This, in part, was related to the diagnosis of WMD in two individuals, a disease of growing animals.

An interesting notation to the compilation of the data was the sex ratios of births. Despite a seeming predominance of males when working in "the field," 51% (258) were male and 49% (246) female. The sex ratio of deaths--51% (73)male and 49% (71) female--was the same.

The institution of the neonatal protocol has had several benefits. The most obvious is a better knowledge of the physical condition of the neonate--its immune status, weight, sera collection for future reference, prevention of WMD, and earlier detection of birth defects and malnourishment. As evident in the previous discussion, the institution of such a program does not take place in a vacuum; genetics and management practices also have significant input into calf viability. In the 6 species with greater than 5 individuals in pre- and postprotocol time periods, the viability of impala, Speke's gazelles and springbok improved, eland and lesser kudu remained unchanged, and sable declined. Lesser kudu and eland already had average of higher 30-day survivability data (82% and 94%) and possible reasons for the sable decrease have been discussed. We do feel that the improvement in the first three species is due in part to improved neonatal care as outlined here.

Though the data presented are not intended to be definitive in the analysis of causes of neonatal mortality, it is hoped that the sharing of management techniques and subsequent survival data will aid in further refinements of neonatal programs. Greater than 90% survival is achievable in cattle operations, but the delicate nature of many exotic ruminants combined with our incomplete knowledge of many dietary, veterinary and behavioral requirements creates an increased challenge in exotic artiodactylid neonatology.

Products Mentioned in Text

[a] Betadine Solution, Purdue Frederick Co., Norwalk, Connecticut 06856

[b] Dextrostix, Ames Division, Miles Laboratories, Elkhart, Indiana 46515

[c] Bo-Se, Burns-Biotec, Omaha, Nebraska 68103

[d] D and H Pelleted Chow, Ralston-Purina Company, St. Louis, MO 63164

[e] Mineral Block 12:12 VA, Ralston-Purina Company, St. Louis, MO 63164

[f] Combi-Pen, John D. Copanos Inc., Baltimore, MD 21225

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Table 1. Artiodactylid Live Births and Survival

	1970-85		1970-79		1980-85	
Species	# Live Births	30-day survival (6 mo, if diff)	# Live Births	30-day survival (6 mo, if diff)	# Live Births	30-day survival (6 mo, if diff)
Addax (Addax nasomaculatus)	9	78%	--	--	9	78%
Blesbok (Damaliscus albifrons)	10	80%	4	100%	6	67%
Eland* (Taurotragus oryx)	35	94%	25	96%	10	90%
Gerenuk (Litocranius walleri)	19	79%(63%)	4	100%(75%)	15	73%(60%)
Greater kudu* (Tragelaphus strepsiceros)	22	50%(36%)	19	53%(37%)	3	33%
Impala (Aepyceros melampus)	56	78%(73%)	21	76%(62%)	31	77%
Lesser kudu (Tragelaphus imberbis)	33	82%(73%)	16	81%(75%)	17	82%(71%)
Sable antelope (Hippotragus niger)	34	79%(74%)	16	100%(94%)	18	61%(56%)
Speke's gazelle (Gazella spekei)	93	75%(66%)	54	69%(54%)	39	85%(74%)
Springbok (Antidorcas marsupialis)	69	68%(64%)	47	68%(62%)	22	68%
Rocky Mt. bighorn sheep (Ovis canadensis)	5	60%(40%)	--	--	5	60%(40%)
Stone's sheep (Ovis dalli stonei)	8	88%	--	--	8	88%
Banteng (Bos banteng)	8	63%	7	71%	1	100%
Gaur (Bos gaurus)	12	75%	3	67%	9	78%
Bactrian camel (Camelus bactrianus)	7	100%(80%)	--	--	7	100%(86%)
Llama (Llama glama)	76	84%(82%)	73	85%(82%)	3	67%
Reticulated giraffe (Giraffa camelopardaus)	10	88%	7	86%	3	67%
Rocky Mt. goat (Oreamnos americanus)	1	100%	--	--	1	100%
Total --	507	77%(72%)	296	78%(71%)	211	76%(71%)

*Species no longer kept at the zoo

BEST COPY AVAILABLE

THE INVOLVEMENT OF CAPTIVE POPULATIONS IN THE RECOVERY OF THE THREATENED GRIZZLY BEAR (*Ursus arctos horribilis* Ord) IN THE LOWER 48 UNITED STATES

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HISTORICAL DISTRIBUTION AND POPULATION STATUS

The grizzly bear was once present throughout most of the western United States and south into Mexico (see Storer and Tevis (1955) (Fig. 1.). With the settlement of the west by the white man, the range of the grizzly bear was reduced through human-induced mortality and habitat destruction.

As human population increased, grizzly populations declined and became limited to remote areas (Fig. 2). The result of this reduction in range was insularization of subpopulations which accelerated population decline. The grizzly disappeared from Texas in 1890, from California in 1922, from Utah in 1923, from Oregon in 1931, from New Mexico in 1933, and from Arizona in 1935 (Storer and Tevis 1955). The present range of the grizzly bear is approximately 49,000 sq. km. in 4 states (Fig. 3). This area does not include the as yet undetermined habitat in the North Cascades and Selway/Bitterroot ecosystems. Population estimates in the lower 48 states range between 700 and 1,000 bears.

The grizzly bear was declared a threatened species in the lower 48 United States in 1975. Since that time efforts have been underway to recover the existing populations to levels where protection under the Endangered Species Act is no longer necessary. Examples of these recovery efforts include habitat management and protection, limiting killing of bears by people, elimination of human foods and garbage from bear access, and public education about bears and their needs for survival. These recovery efforts involving the coordination of many State, Federal, and private agencies and groups are beginning to show some results with improved habitat protection, enlightened management, and increased law enforcement to limit illegal kills.

These actions are not enough for some populations, however, and other actions may have to be taken to effect recovery. One of these other actions is the augmentation of existing populations with bears from other areas. Augmentation would entail placement of bears in an area where the population is so low that an increase in numbers from natural reproduction in the area is either too slow or not possible given the age and sex structure of the existing small population. No augmentation has been tried to date, but plans have been developed to begin such an effort in the future if existing political and biological concerns can be met.

At present there are two methods of augmentation under serious consideration. The first involves taking carefully selected wild bears from an area of high population density and placing them in the area to be augmented. These bears would be carefully monitored after release in the area and plans would be available to deal with them should they get into trouble with people or leave the target area. This method has some limitations in that grizzly bears have a tremendous ability to return to their place of origin after they have been moved. Certain bears which have been moved because of conflicts with man have traveled over 100 miles to return after being placed in new locations away from people. Even if relocated bears remain in the relocation area, they are often not well adapted to the habitat and food distribution in their new home.

The second method of population augmentation would require the participation of zoological parks. This method would involve the cross-fostering of captive-raised grizzly bear cubs to resident black bear (Ursus americanus) females in the target area. Black bears and grizzly bears are sympatric throughout much of their range and their food habits and habitat use are very similar. Cross-fostering has the advantage that the cubs could not "return" and if they were accepted by the black bear female they could learn successful feeding strategies, habitat use, and avoidance of man and human activities during the two years they would remain with their foster mother.

Interspecific cross-fostering has never been tried in the wild on bears. Intraspecific cross-fostering has been demonstrated successfully on black bears where orphaned cubs were placed with adult females who had cubs of the same age (Clarke et al. 1980, Alt and Beecham 1984). In the case of black bears, the orphaned cubs were placed in natal dens prior to emergence of the foster mother and her natural young in the spring. Orphaned cubs were also placed with lactating females in the wild by placing them with wild females or by capturing and immobilizing females and temporarily blocking their sense of smell so they could not discriminate between the foster cubs and their own. Of these introductions, 25 of 45 (55.6%) were successful. Of those placed in natal dens with family groups prior to emergence, 23 of 29 (79.0%) were successful.

Ideally, this cross-fostering should be tried in captive bear populations prior to its use in the field. Zoological parks would be the only areas where such a test is even feasible. If it is not possible to test the technique in captive populations, it should still be tried in the wild because of the urgency to maintain and recover small isolated grizzly bear populations before they disappear. The productivity of captive brown bears is such that cubs are surplus and in many zoological parks the females are prevented from breeding to prevent unwanted cubs. Thus, the potential loss to the captive breeding stock is minimal while the potential benefit to the threatened wild population is great should the effort be successful.

LOCATIONS FOR AUGMENTATION

At present there is a research project underway in the Cabinet Mountains of Montana on the small, semi-isolated resident grizzly bear population. This research effort involves radio-tracking three wild grizzly bears in this area. Of the three bears captured since the study started in 1982, the only female is now 32 years old and has never been with cubs. This bear may be the oldest grizzly bear ever captured in the wild and her lack of cubs over three years is a strong indication that she may be past reproductive age. This heightens the concern about this population and the need to do something to augment the population. This area has little functional connection with other contiguous populations and it is unlikely that other bears could or would immigrate into this area naturally. The grizzly population in this range may be as low as 10-12 bears.

As part of this ongoing project, nine adult female black bears have been radio-collared and have been tracked for two years. This information has established the reproductive cycles, behavior toward man, and home range areas of these females so that those with the optimum ranges and behaviors can be selected as foster mothers for grizzly bears. These data now provide a firm basis for the initiation of a cross-fostering test effort in the Cabinet Mountains.

SCENARIO FOR THE CROSS-FOSTERING TEST

The selection of a male and female grizzly bear with the proper genetic backgrounds is the first step in the cross-fostering process. These animals would preferably be of known origin with a record of not having been the young of related parents. The preferred animals should come from southern interior grizzly bear populations in either the lower 48 states, British Columbia, or Alberta. Parents from coastal populations in Alaska or British Columbia should be avoided because of their larger phenotypic characteristics. The key would be to match the parents from as close an area as possible to the Cabinet range. These animals would be bred in June or July in a facility where the female has an maternity den where she can be observed and where she can be separated from the cubs easily in March. The female would preferably have a history of cub production and proper maternal behavior in a captive environment to assure survival of the donor cubs.

The field portion of the cross-fostering scenario would begin with the selection of two to three adult female black bears who entered their dens with a high probability of having cubs over the winter. These animals would be selected in the areas where the fostered grizzly bears would have the least conflict with people and where their ranges would provide a high degree of solitude and security from any planned land management actions. The den sites of these selected females would be marked, and their accessibility would be another factor in their selection. The dens must be accessible in March and they must be large enough to be entered by the research team when the cub transfer is made.

The next phase of the test would be the birth of cubs in both the captive grizzly bears and the wild black bears. The number and condition of the grizzly cubs would be monitored and the birth of cubs in the black bears could be substantiated in the potential foster black bears. Final selection of the foster black bear mother would be made based on birth of cubs, den location, and den accessibility.

The final portion of the test would involve removing the grizzly bear cubs from the captive mother and the selection of animals of the proper sex. At present, it is felt that female grizzly cubs would offer the most to the population and would suffer the least detrimental behavioral effects from being raised by a black bear. The cubs would be isolated from human contact and would be rushed to the Cabinets area. Because this transfer would have to be rapid, a private plane would be preferred. Additional considerations prior to beginning the transfer would include the weather at the time of transfer at the foster mother's den site so that the area was accessible during the 24-48 hour transfer period.

When the grizzly cubs arrive at the site, the foster mother would be immobilized and her cubs would be removed and replaced with preferably two female grizzly cubs. The displaced black bear cubs would be fostered to another black bear female. The foster mother would be treated in the same manner as those in the successful fosterings reported by Alt and Beecham (1984). She would be carefully monitored after the transfer and upon emergence for any sign of rejection of the grizzly cubs. If she successfully emerged with the grizzly cubs, she would be carefully monitored for several years and the fostered cubs would continue to be monitored after they left the black bear mother to determine the ultimate success of the effort.

THE ROLE OF ZOOLOGICAL PARKS

Cross-fostering between grizzly and black bears can only be tested with the assistance and cooperation of zoological parks. The use of any such a dramatic and potentially beneficial conservation measure will rely on the experience and facilities of interested zoological facilities.

Zoological parks can also be useful the grizzly bear recovery effort by acting as depositories of breeding stock of known origin. Each year several grizzly bears must be removed permanently from the wild because they come into repeated contact with man by eating livestock or frequenting campgrounds. These animals are a valuble resource of genetic material for possible future cross-fostering attempts. There is some concern that the genetic diversity of some isolated grizzly populations such as the Yellowstone may be depleted by continued inbreeding. This situation could be remedied by placing animals of known genetic stock into these inbred populations to increase the genetic diversity of these populations. If zoological parks could take some of these nuisance animals and hold them then they would be available as living gene banks should their genetic stock be needed.

As further effort arising out of this concern about the genetics of wild grizzly bear populations, we are now in the process of studying the gentic diversity of wild and captive bears. If zoological parks could assist this study by collecting blood and tissue samples from their bears this increased sample size would greatly assist this effort. Of special importance are samples from bears of know origin and from offspring of related animals.

SUMMARY

The conservation of threatened and endangered species is an effort which must increase in scope and intensity if we are to be successful in even a small way in stemming the massive wave of extinctions now underway in the world. In order to meet this challenge, we must use every tool at our disposal to do what we can for these species before it is too late. The use of techniques such as cross-fostering and gene banks with the cooperation of zoological parks will allow us to do all we can to establish viable, self-sustaining populations for species such as the grizzly bear in the lower 48 United States.

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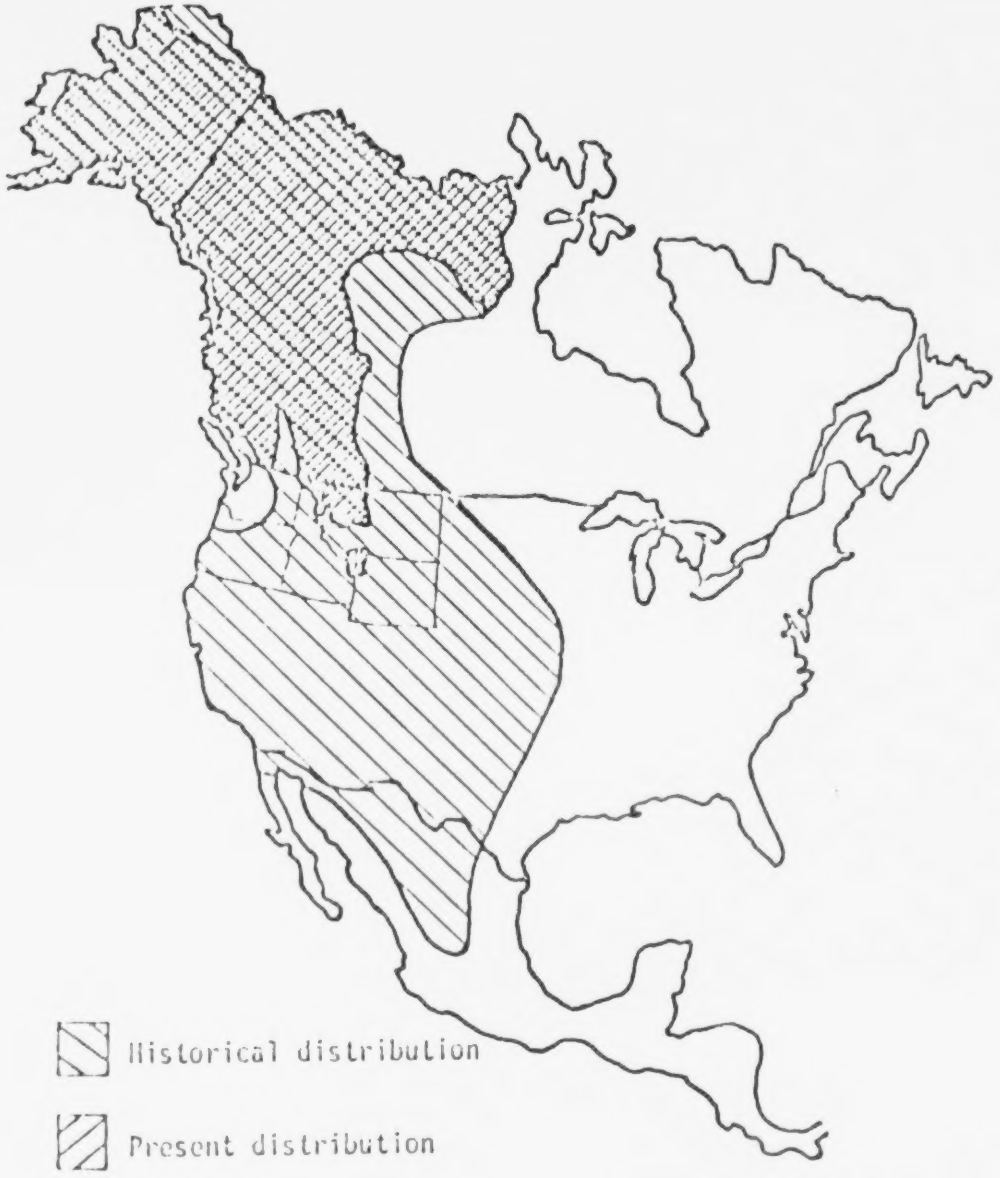
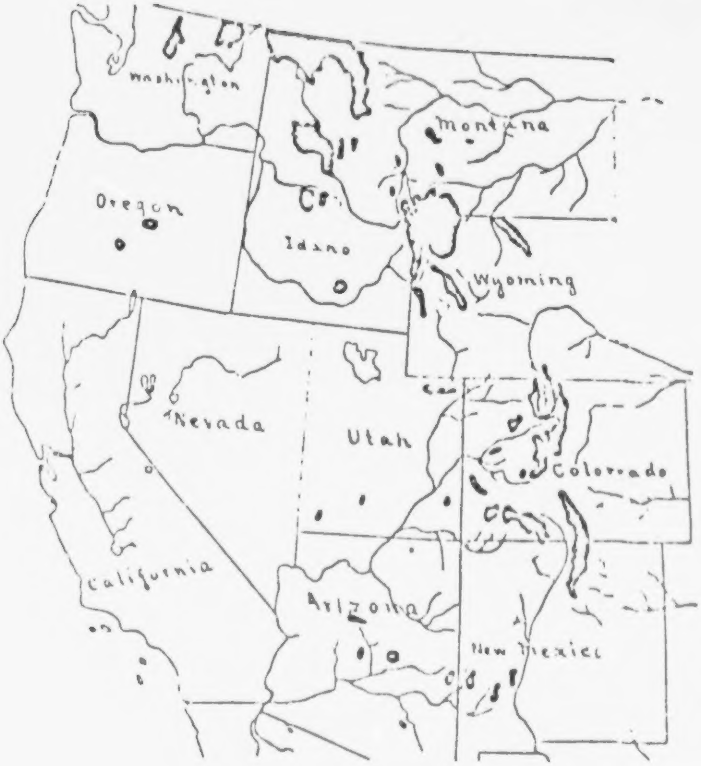

Historical distribution
Present distribution

Historic and present distribution of the grizzly bear in North America
(from Zager 1980)

Figure 1. 549


Washington
Montana
Oregon
Idaho
Wyoming
Nevada
Utah
Colorado
California
Arizona
New Mexico

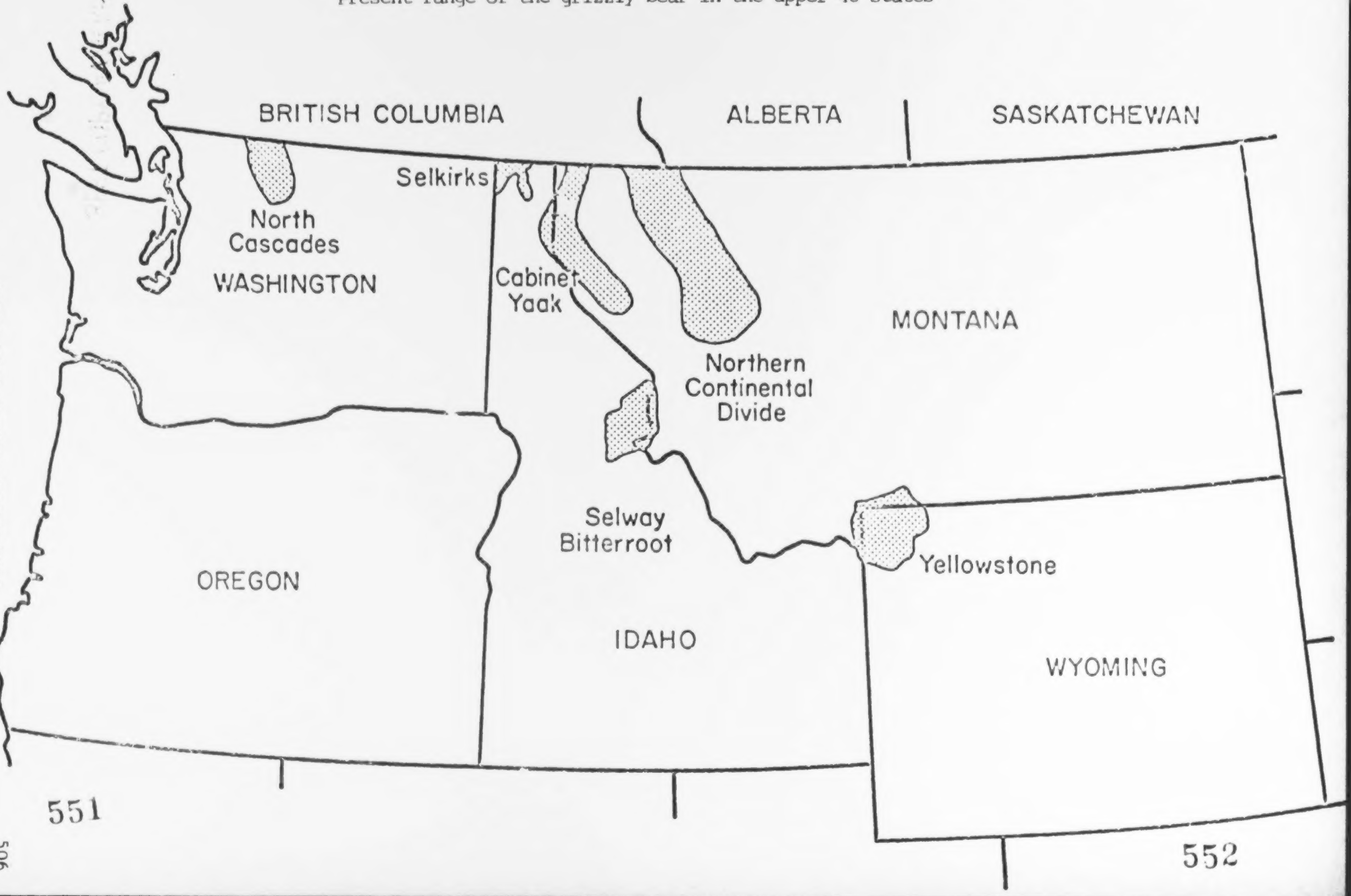
Distribution of the grizzly bear in 1922

Figure 2.

BEST COPY AVAILABLE

Figure 3.

Present range of the grizzly bear in the upper 48 states


BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
Selkirks
North Cascades
WASHINGTON
Cabinet Yaak
Northern Continental Divide
MONTANA
Selway Bitterroot
Yellowstone
OREGON
IDAHO
WYOMING

MARKETING TO NEW AUDIENCES --
OR, PROSPECTING FOR TRENDS TO THE YEAR 2000

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Introduction

In talking about marketing to new audiences, or perhaps overlooked audiences, I want to highlight some trends and relate recent demographic information about potential audiences to psychographic, or attitudinal, data about them. As we head into the final 15 years of this century, we need to prepare ourselves to meet sociological, economic, and political changes affecting our communities, to prepare ourselves to cope with changing public evaluations and expectations of us.

In a paper at AAZPA last year, I summarized my research into why people do and do not visit zoos, aquariums, museums, nature centers, and other cultural, recreational, and nonformal educational sites that I characterize as "preservation-exhibition" institutions. As I noted then, our current visitor population is not a homogenous body. It is, in fact, a bifurcated entity, based on its psychographic characteristics--its values, attitudes, expectations, and satisfactions. There are a small loyal group of frequent visitors to our collections and a larger group of occasional visitors.

The frequent visitor, who is likely to be in the upper education, occupation, and income groups, is primarily interested in opportunities to learn, to have a challenge of new experiences, and to do something worthwhile in leisure time. This person fits our expectations of what visitors should be and how they should respond to our educational efforts. These are our members, volunteers, and supporters, and we love them.

On the other hand, the occasional visitor, who is more likely to be in the middle education, occupation, and income groups, is not as easy to reach or to love. He highly values three other attributes of leisure life--social interaction with family and friends, active participation, and feeling comfortable and at ease in his leisure surroundings. Since this person often feels zoos and aquariums have not made much effort to provide him with the kind of leisure experience he values, he doesn't visit us more than once or twice a year.

Inasmuch as we are already satisfying the frequent visitor, it behooves us to incorporate into our planning and programming more of the qualities that the occasional visitor prizes, so we can bring him into our fold more often. That means offering more than one form of outreach or emphasis, more than one type of programming or service, for if there is any hallmark of American life at present, it is differentiation--in products, communications, family lifestyles, leisure choices. People expect to be able to choose from among many alternatives. They expect to find goods and services tailored to meet the needs of special interest groups--that's the essence of market segmentation or target marketing.

Therefore, let's take a look at some demographic trends to watch, so you can prepare to meet the psychographic expectations of new or overlooked audiences. I will summarize data relating to four specific groups--families, young singles, older adults, and workers.

Families

All of our institutions place high priority on attracting the family audience--but which or how many family audiences are we talking about? I find that many organizations still think of "the family" as consisting of husband, wife, and children living together--a family group that comprises only 29% of American households today. Among married couples, only 49% have children at home, compared with 57% in 1970. Twenty percent of American children live in one-parent families.

Does this mean "the family" has disappeared? No--but it has taken on new forms. With divorce ending 47% of marriages, and about 80% of divorced persons remarrying, we have many diverse types of families. In a recent paper I wrote for Marriage and Family Review, I counted nine different types of households in which children live--including single parent, stepfamily, and binuclear family arrangements. These units are families too, and they are expecting us to serve them also.

However, these families may have different values, expectations, and abilities than traditional families. One result of recent changes has been the increase in poverty among female-headed single-parent households. One-third of all households headed by women are poor; one in five American children now lives in poverty. Another effect is that 70% of single parents work; but, also, both parents work in more than half the families in which both mother and father live in the home.

If we want to continue to serve parents and children, we must be aware of changing family structure and create new modes of reaching them. We might follow the example of the Siouxland Heritage Museums in South Dakota, where the director noticed that on Saturdays, there were more fathers with children at the museum than mothers with children. Deducing that these were noncustodial fathers entertaining their children for the day, he increased his Saturday programming of intergenerational activities. While not specifically designating these Saturdays as Divorced Dads Days, he is acutely conscious of providing special events every month to meet the needs of this special audience. Now, that's target marketing!

Reaching these nontraditional families in a direct and personal way can be accomplished through groups like Parents Without Partners and Y, church, and community center organizations for single parents. Designating a "Parents Without Partners Day at the Zoo" affirms that all types of families are O.K. and will be hospitably received.

We also need to think of marketing to families of different ethnic background, especially to zero in on nonwhite families. Even when black guests have had the demographic characteristics of our frequent visitors, they have not always felt welcome in our institutions. Fortunately, that is less true today than five or ten years ago.

But, for developing new audiences, we must look to Hispanic and Asian families, who have higher birthrates than whites or blacks and who are very family-centered in their leisure activities. Within 15 years it is estimated that 30% of the population of several states will be members of minority groups. Are we planning now how we will market to them? Do we announce ourselves through their language newspapers, posters, radio, and TV? Do we aim to reach them through their religious, business, social, and support organizations? At their naturalization classes or ceremonies, do we offer as a salute to citizenship, a guest pass to a free visit to our institution?

The number of non-English speaking Americans is growing; in 1980 it was 23 million; by 2000 it is estimated to be 40 million. Can an object-oriented institution like a zoo or aquarium offer these potential patrons a satisfying experience, with or without communication through a common language? Or, acknowledging their different cultural backgrounds, can it provide labels and brochures in more than one language?

As you help these new audiences understand your institution now, do you anticipate the day when the organization may need them--their membership, their vocal support, their vote? Will they then be able to respond positively by asserting that "the zoo has treated me well; it isn't just for white people, for rich people, for well-educated people." These folk will numerically comprise a major portion of your potential family audience of the future. Your task today is to integrate them into your marketing plans.

Young Singles

As a counterpoint to the family audience, we must recognize that an increasingly large proportion of our population lives in households without children. Married couples without children comprise 30% of American households; they are mostly people over 50 years old. The second largest group without children is single persons, who total 23% of American households. These two units plus cohabiting couples comprise 57% of all households--and these groups are growing rapidly while the one with children has been shrinking. Childless couples and singles are the people you have to woo if you require voter support for your tax levies and bond issues; they have the political clout. Schools and libraries will also be wooing these folk, because only 30% of today's voters have children in school.

Single-person households are the fastest growing type of household in the United States. By 1990 it is predicted that one-quarter of all households will have only one person in them. What opportunities and satisfactions do zoos and aquariums offer to singles? Are we balancing our emphasis on attracting families with efforts to involve the growing number of young working singles? Can we reach them through company, professional, union, social, and singles organizations to arrange group visits to the zoo or aquarium? Again, Y's, churches, and community centers program a variety of trips for special groups like singles; have you contacted them through their newsletters, program chairmen, and special events coordinators?

Young professional singles also are prime candidates for your volunteer corps. They offer organizational, public relations, and fund-raising skills, as well as acting as ambassadors to their social groups. Especially those singles new to a city look to cultural, recreational, and nonformal educational organizations as places where they can meet and socialize with persons of similar interests and work status. These young singles seeking a friendship group and an outlet for their volunteer enthusiasm have all the right demographics to fit into your frequent-visitor category. Are you letting them know you value them and welcome them, and that you are not only a family-centered enterprise?

Older Adults

In 1984, for the first time in our history, the number of persons over age 65 exceeded the number of teenagers. Fifteen years from now, there are expected to be 8 million more people over 65 than there are teenagers. Are you preparing to shift your emphasis from serving children to serving older adults?

As more people, especially executives, are retiring in their 50's and 60's, many have the health, desire, money, and time to travel and to participate in nonformal educational programs and volunteering. Though these folk may not have had time for us during their busy work years, they may be looking for an opportunity to put their energy, experience, and expertise to good use in a volunteer capacity, or at least as members of our institutions.

The 45 million Americans over age 50 constitute our largest and fastest-growing leisure market. Are you paying attention to how you can capture their patronage? Are you reaching them through your community's senior centers, tourism bureau, bus tour packages, and their specialized publications?

Elderhostels are increasingly popular programs for older adults. Has your zoo or aquarium considered how it might tie in with a local college's Elderhostel program on zoology, biology, environment, or ecology? In 1983, more than 700 educational institutions in 50 states and Canada had Elderhostel programs. In 1984, it is estimated that more than 50,000 older persons were enrolled. Consider how your institution might benefit--and benefit from--these enthusiastic older adults who are looking for learning experiences served up with TLC.

Producers of tangible goods fear what this aging of America portends, because elderly persons don't consume as much in goods as do young people, but they do require more in services. As community service agencies, zoos, aquariums, museums, and nature centers are in a good position to satisfy older people's interests if they prepare now to meet the seniors' specific needs. Older visitors may have difficulty walking around, may have trouble reading miniature labels, and may need frequent resting places and washroom facilities. Though older adults are just as interested in and respond as well to nonformal learning opportunities as younger visitors, the social aspects of the visit are equally important to them. Studies show they often prefer to come in groups of their peers, to interact with tour or session leaders, and to have a social time to discuss the experience with their family or friendship group before they leave.

"Must reading" for all of our institutions is the fall 1984 issue of Roundtable Reports, which features articles dealing with older adults--what they expect from us, how normal sensory changes affect their ability to respond to our environments, and how several institutions have adapted their programs to serve older adults effectively. One of the case studies is the New England Aquarium's EldeReach program. If your education department is not now subscribing to Roundtable Reports, which was recently retitled The Journal of Museum Education, borrow or order a copy of the fall 1984 issue. ($5 each back issue, $20 subscription for four issues, from Museum Education Roundtable, P.O. Box 8561, Rockville, MD 20856)

Workers

In my recent consulting with zoos and museums, I have found that most of these institutions are concerned about their stable or declining attendance. One thing we may be overlooking is that Americans just have less time to spend with us--they are working longer hours and more irregular hours. A survey last year found that Americans had lost an average of eight leisure hours a week between 1974 and 1984.

As more households require two salaries, time management has become an increasingly important factor. Especially in homes with young children and two working parents, the time crunch is severe. What will they cut out? The zoo or aquarium visit can survive the cut if it is perceived to be a leisurely, refreshing, renewing personal experience, where the individuals can enjoy each other's company as much as they do the animals and the setting.

We all have two resources to spend--money and time. While families and individuals may be earning more money, it is at the expense of free time. This is not only because people are working more hours, but because more people are working odd hours on schedules that don't fit our traditional formats. Shift work is increasing, especially in high technology, health, and communications fields, which means that the people who are increasingly the shift workers are our people--those who have the demographic and psychographic characteristics of frequent visitors, members, supporters--the people with upper education, occupation, and income. Not only are these typical frequent visitors more likely to be working shifts, but professional and technical workers report the highest rates of moonlighting.

Zoos and aquariums have to compete for time and attention in a highly-pressured environment. How will you respond? When these families are able to spend their precious, limited hours together, will they find the zoo or aquarium to be a relaxing, enjoyable place to stroll, to socialize, to share a family experience? Also, can you stay open a different schedule of hours to accommodate them, without deleterious effects on the animals? Might you offer flexitime in work schedules and flexibility in programming to satisfy the changing needs of your visitors? Will your staff adapt to a different work schedule?

Though some analysts express concern about another changing aspect of the workforce, it might actually redound to the benefit of cultural and educational institutions like zoos and aquariums. This phenomenon, described as "overeducation, underutilization, and underemployment," means that many well-educated workers are unable to secure jobs that equal their educational attainment. Perhaps more than 25% of recent college graduates are overqualified for their current jobs, and the problem is likely to become more widespread.

While many of these folk will be frustrated and unfulfilled in their work, our institutions may be the beneficiaries. If these people cannot use their talents on the job, they may welcome the challenge and satisfaction of serving our institutions as volunteers--to obtain an outlet for their organizational, creative, and technical skills. Are you assessing where these able volunteers might be utilized--not just in traditional roles as docents but in long-range planning, communications, technology, community outreach? You need to be creative in thinking of ways to capitalize on these persons' inability to employ all of their talents on the job.

Finale

Marketing researchers claim that convenience, comfort, pleasure, and simplification are four attributes of products and services demanded by American consumers today. As people lead more complicated home and work lives, they prefer to spend their leisure hours in places that are easily accessible, comfortable and pleasant, and physically or emotionally satisfying.

We often make our job of marketing to new audiences harder for ourselves by failing to grasp the visitors' point of view, by failing to be sensitive to audience needs and values. As you walk around your grounds and buildings, pretend you're a first-time visitor. What attracts your attention--both positively and negatively? What is missing? What deserves enhancement?

Our visitors take for granted that we will provide high quality exhibits, a well-rounded program, easy-to-read labels and brochures, clear directions, comfortable resting places, reasonably good food services, a well-stocked gift shop, adequate washroom and baby service facilities, friendly personnel, and a variety of membership benefits.

How might you better meet visitor expectations--not only by providing worthwhile and challenging new learning experiences, but opportunities for social interaction, active participation, and enjoyment in comfortable surroundings?

The most important marketing factor for any leisure place is making its publics feel welcomed and appreciated, letting them know that the staff, administration, trustees, and docents care that they chose the zoo or aquarium from among many leisure options. Particularly when you are marketing to special groups--the nontraditional families, the nonwhite communities, the young professional singles, the older adults--you need to convey the message that it makes a difference to you that they are willing to spend their valuable time with you. When they know you care about them, they will care about you and will respond to your marketing efforts and to your conservation message.

Therefore, embrace a marketing perspective, whereby the zoo or aquarium sees itself in competition with other leisure activities (other area leisure places, plus home-based activities such as TV and gardening). In this process, examine your attributes and programs in relation to how competing activities provide attributes that are valued by potential audiences. Design your outreach efforts toward targeted audiences, emphasizing the benefits of involvement that appeal to individual audience segments.

In such an effort, the zoo or aquarium must recognize that, working with limited funds and staff and volunteer time, it will take longer to reach a targeted audience than if a profit-making organization were selling a product. In the latter case, exact budgets and turnaround time can be calculaed, based on the number of advertising impressions required to move an unaware segment of the public into the buying public. This requires coordination of the four "P's" of marketing--product, place, price, promotion--to deliver the message and product in a precisely-orchestrated campaign. A nonprofit organization must expect to invest years of steady, constant effort to accomplish what a multimillion dollar campaign can achieve in six months. The same basic techniques are applied, but less intensively and over a longer time period. And there are advantages in having a longer time frame: opportunities to modify the approach and to build on interim developments.

All efforts must be coordinated to create a cohesive campaign that is evaluated and fine-tuned frequently during the process. Marketing to new audiences is not a hasty undertaking; it requires careful conceptualization of the process and goals, a substantial ongoing effort, and willingness to withhold judgment until a new technique has had time to work. And as your constituencies continue to change, modifications in your marketing program must be incorporated, in order for you to reach your new or overlooked audiences with clarity, precision, and efficient use of your resources.

RIVERBANKS ZOO

A CASE STUDY FOR GROWTH

Palmer Krantz

Riverbanks Zoo is one of America's newest zoos, having opened on 25 April 1974. Like other public institutions which opened in the 1970's, Riverbanks Zoo experienced several years of severe growing pains as we tried to cope with tax revolts, runaway inflation and changes in America's travel and vacation habits. If these problems alone were not bad enough, Riverbanks Zoo had an additional burden to bear--an antagonistic citizenry which was not all that certain it even wanted a zoo.

In the course of the next several minutes I would like to tell you how our zoo coped with these problems and now, in fact, faces a major expansion program.

Saying that Riverbanks Zoo opened with one foot in the grave would be like saying the Titanic bumped into an ice cube. Two years behind schedule, $3 million over budget and a growing operating deficit to boot, Riverbanks Zoo opened amid a sea of controversy. In addition to the above-mentioned problems, the $2.25 adult admission fee was not announced to the public until less than 24 hours before the Zoo opened. Interestingly, this was the first mention of any admission charge during the entire five-year development of the zoo. Needless to say, the public was less than enthused about Columbia's new zoo.

I don't mean to imply that there was no advance positive publicity. Numerous press releases and interviews with zoo staff members were held throughout the years preceding the Zoo's opening. While a certain amount of excitement was generated, the public's overall attitude was somewhat subdued--after all, no zoo had existed in Columbia since a circus went bankrupt in the city in 1915. Prior to our opening, the closest zoo to Columbia was a five-hour drive away.

This fact plagued Riverbanks Zoo for a number of years. We had developed what we felt was a very nice zoo. We were, therefore, somewhat perplexed when many early zoo visitors seemed to take the Zoo's quality for granted. It wasn't until several years later when Columbia-area residents, spurred by their interest in Riverbanks Zoo, began visiting zoos in other cities, that a true appreciation for "their" zoo developed.

Riverbank's first year of operation did show some promise as media reviews and public reaction to the Zoo were generally good. However, we then had a new, very significant problem to overcome--operating deficits! Throughout the period of development and construction, the Zoo was promoted as being a self-supporting attraction. Attendance and revenue projections were made to justify this concept. Unfortunately, no in-depth analysis of these projections was ever made. Looking back at those projections, some very interesting facts emerge. The projected annual attendance figure would have been nearly impossible to attain simply because the Zoo's parking lot is not large enough to accommodate the number of cars resulting from the projected attendance figure. Further, the Zoo's food and gift facilities were not designed to adequately serve the numbers of people needed to generate projected operating revenues.

As a result of these and other such problems, Riverbanks Zoo began to accumulate a rather large operating deficit--and with it, a very serious crisis--some very knowledgeable and influential citizens were calling for the Zoo's closing--less than two years after opening! One imaginative county council member even made front page headlines with his suggestion that someone "should take a bulldozer and push the whole damn thing in the Saluda River."

Such was the political climate when, in April 1976, the Riverbanks Park Commission made two significant changes--one in management, the other philosophical. As a result of the management change I was made the Zoo's second director. The philosophical change, however, was much more subtle--change the Zoo's public image and oh, by the way, don't spend any money. This last statement was made due to the fact that by this time, the Zoo had amassed a $170,000 deficit!

Our plan to shape the Zoo's image into a positive one was quite simple--we kept our collective mouths shut for approximately two years. However, prior to our vow of silence we let both the politicians and press know that we would begin a very serious effort to clean up the Zoo's financial mess. For this to work we would need their help--the politicians would have to trust our pledge of fiscal responsibility and give us the time necessary to bring about change. For their part, the press agreed to let up on coverage of the zoo "controversy" and begin to carry more positive, constructive stories. I say the word controversy in quotes because we always felt that no controversy actually existed, merely a misunderstanding as to what a zoo was and the role it was expected to play in the community.

We demonstrated our commitment to fiscal responsibility by immediately cutting the zoo staff 25 percent. This rather dramatic action was actually fairly easy to accomplish. Because of the Zoo's uncertain future, coupled with low salaries, we were experiencing an extremely high employee turnover rate. Thus the 25 percent cut was accomplished in a rather short period of time through attrition. This gave the community the appearance of a hard-hitting and decisive action after years of seemingly runaway spending. Through this and other cost-saving measures, the Zoo actually maintained the same operating budget from 1976 to 1979. These were the stories which began appearing in local newspapers.

There was one other significant development made during this time which, perhaps more than anything else, helped to bring about a radical change in public attitude--the formation of the Riverbanks Zoological Society. There had been one other attempt previous to this at establishing a zoo support organization. This group, The Greater Columbia Zoological Society, was doomed from the start. For example, for your annual membership fee of $25.00, you received four free passes--one for each season of the year--winter, spring, summer and fall.

The 200 dedicated souls who joined this initial effort were used as a nucleus to establish the Riverbanks Zoological Society in October 1976. This new Society was established along traditional zoo society lines: free admission, newsletter, special events, etc. Shortly after announcing the Society's formation, we hit upon the bright idea of placing a Society membership application in the City of Columbia's water bills. For approximately $500 applications were distributed. You can imagine our surprise when this effort actually yielded

1,000 new members! At this point we realized we were on to something much bigger than we first anticipated and began to view the Society in a whole new light. We also had, for the first time, our feelings realized--that the Zoo was supported by the famous Silent Majority.

In the years since 1976 we have utilized the services of two direct mail consultants and now boast a Society membership of over 13,000. This figure becomes ever more significant when you realize that the metropolitan population of Columbia is just over 400,000. Therefore, one out of every seven citizens in the Greater Columbia Area is a member of the Riverbanks Zoological Society. The Society now contributes over $175,000 annually to the Zoo's operating budget in addition to conducting capital fund campaigns for special projects, such as the zoo's new $600,000 Education Center.

With renewed faith in the Zoo's ability to manage its financial affairs, plus a growing base of community support, things began turning around for Riverbanks Zoo. In fact, we felt so confident about our position within the community that in 1980 we were successful in having our local government agencies vote to fund the zoo's annual operating deficit. Almost overnight we eliminated a $107,000 deficit and have since operated with a surplus of funds.

Over the past five years we have begun to move from a conservative approach in public relations and marketing to a more aggressive one. As mentioned above, in 1982 the Zoo Society conducted a successful $600,000 capital campaign to construct an education center in the Zoo. Carefully targeted marketing (we still spend very little on promotional activities) has resulted in increased attendance. In 1984 over 400,000 people visited Riverbanks Zoo, establishing the Zoo as South Carolina's largest public attraction. Visitor surveys indicate that approximately 25 percent of these visitors were out-of-state tourists, confirming what was long felt to be fact, that we were attracting large numbers of tourists to the Columbia area--a fact which we are quick to point out to local politicians.

Other factors have also added to the success of Riverbanks Zoo. Staff members are encouraged to actively participate in local, national and international organizations. The Zoo is featured regularly on commerical and public television and radio networks. And of course, there was the infamous Parade magazine article in February 1984 which named Riverbanks as one of America's ten best zoos (whatever that means).

This brief history lesson was given to help highlight the main theme of this presentation--when does a zoo actually know that it's time for a major expansion effort? Obviously, in our case, we could not have thought of expanding during the first eight years of our zoo's history. However, now that things are turned around for us, how do we know it's time to expand?

Before I get into the nuts and bolts of how we actually arrived at the decision to expand, let me say a brief word about visitor surveys. It is my personal opinion that visitor surveys are perhaps the most important tool we have as managers of public places. Twice in the past six years - 1979 and 1983 - we have conducted extensive visitor surveys at Riverbanks Zoo. Each time we utilized the services of a professional marketing research firm to conduct the surveys and analyze the results.

Our 1979 survey was conducted with little thought given towards the end result. We knew of certain questions we wanted answered--where people came from; how long they stayed; favorite and least favorite animals, etc. What we didn't know was how to ask follow-up questions for certain key answers. For example, visitor origins are important. But perhaps more important are why out-of-state visitors decide to visit Riverbanks Zoo; are those visitors staying with relatives or are they staying in hotels and motels? These were the types of questions we asked in 1983. Little did we know that when developing our Phase II expansion plan and then selling that plan to local politicians just how valuable these surveys would be.

So, just what were the key elements involved in the expansion decision?

First, attendance. In spite of the Zoo's success and a very supportive Zoological Society, zoo attendance has remained relatively flat for the past several years. The reason for this is quite simple. Since opening eleven years ago, there have been no major new exhibits added to the Zoo. While this alone is certainly cause for concern, we are becoming more and more concerned about competition. For years we have been "the only show in town." However, in the past five years we have seen the opening of the North Carolina State Zoo, and in the next five years the State of South Carolina will open a new State Museum in Columbia, while only two hours away the City of Charleston is developing a major aquarium. A static, unchanging zoo combined with competition from other high quality attractions will almost certainly cause a decrease in future attendance. This cannot be allowed to happen.

Our second area of concern involved earned revenue. Like many zoos, our visitor revenue producing facilities, particularly food and souvenirs, were given a relatively low priority during the zoo's initial developmental stage. This resulted in facilities which are totally inadequate to produce maximum revenue potential. This is not to say that our existing facilities have not been profitable. For example, our only gift shop/souvenir stand has 800 square feet of floor space, yet in the 1984-85 fiscal year this small shop produced over $300,000 in gross sales. This figure becomes even more significant when you realize that previous surveys indicate that only 30-35% of all zoo visitors even enter the shop. (This is due to the poor location of the gift shop plus the fact that the facility is extremely crowded on peak days.)

This combination of stagnant attendance and limited visitor revenue leads to the third and final element of the expansion decision--increased operating expenses. Such costs as salaries and utilities will surely rise in the coming years, placing an increasing burden on the Zoo to at least maintain its current level of 65 percent self-sufficiency. Because of the attendance and earned revenue problems this will be an almost impossible task. Therefore, additional funds are needed in order to maintain the Zoo's financial stability. These funds can only be derived from two sources: (1) improve the Zoo's operating performance or (2) ask the local governmental agencies for increased subsidies. The realization that we may soon face the possibility of going back to the two counties and asking for increased funding was the motivating factor behind our expansion plans.

Now, we had a goal--maintain or improve the zoo's self-sufficiency level. Next, we had to formulate a plan to make that goal a reality. We started by conducting a series of staff meetings, designed to allow for a thorough self-examination of existing problem areas and to develop a list of criteria deemed necessary to the success of the expansion project.

The self-examination effort proved to be somewhat simple. Through an analysis of the Zoo's financial records, combined with data from visitor surveys, we were quite aware of our shortcomings. Thankfully, we were blessed with a superior level of quality in our exhibits. However, we had some very serious visitor service problems. Parking, even for the existing facility, is extremely limited. Numbers of cars are routinely turned away from the zoo on peak attendance days. Food and gift facilities, as previously mentioned, are extremely limited. It is not at all unusual for visitors to stand in line for up to 30 minutes to make a food purchase. Therefore, our first priority was to improve visitors services, not only for visitor convenience and comfort, but also to make them more profitable.

Even though we are blessed with quality exhibits, as previously mentioned, no new exhibits have been added to the Zoo since its opening in 1974. Here again, our surveys proved to be invaluable. For example, both surveys were conducted in August, which resulted in the fact that the single biggest complaint by zoo visitors was the heat. While we could do nothing about our Sun Belt climate, we knew that we would have to incorporate more controlled-environment space. We also knew, both from the surveys and our own knowledge of the zoo profession, that we lacked a high-impact exhibit, such as great apes or reptiles. This fact is constantly brought to our attention by zoo visitors. This became our second priority--build high-impact, controlled-environment exhibits.

Our third and final priority is actually a combination of the first two. We know from our friends in the theme park business the importance of the average length of stay in our facilities. Currently, the average length of stay in Riverbanks Zoo is one hour and 45 minutes. We know that by keeping our visitors in the Zoo longer, they will spend more money. It's as simple as that.

To summarize, our list of criteria are:

(1) Develop one or more high-impact exhibits, incorporating as much indoor exhibit space as possible. This, in turn, will stimulate attendance.

(2) Improve visitor services--parking, food and gifts, and make them more profitable.

(3) By combining one and two, increase the average length of stay.

Following this self-examination, we began the task of selecting an architectural firm to help develop our ideas into concepts which could be put on paper. This would then become our Master Plan for the Phase II expansion of Riverbanks Zoo. Thankfully, we chose an architectural firm which understood the uniqueness of zoos and the importance of the zoo staff's input.

We then spent a considerable amount of time in conceptualizing the visitor services facilities to be included in the Master Plan. Unlike the zoo's initial effort where, once it was decided that the Zoo would sell food, the architects were allowed free reign in designing our food service facilities, we carefully researched and analyzed the various options available to us. Based on such factors as annual attendance, weekly and daily attendance patterns, food revenue history, and the potential for catering special events, a concept began to take shape. The concept developed into a typical fast food-type restaurant with indoor seating for 125 people. Additionally, the kitchen area has been designed so that large events can be catered on-site, thus providing additional earned revenue.

Due to the fact that our existing gift and souvenir shop is entirely too small and poorly located to attract maximum visitation, a new, 2,000 square foot shop has been included in the Master Plan. This new shop will be located at the Zoo's exit, again in an effort to maximize revenue.

As "zoo people" the most pleasant part of this process was in choosing new animal exhibits. Again, we brainstormed for several days, taking into account visitor wants along with our knowledge of the profession. What emerged from this effort was our desire to construct a reptile house, aquarium, and farm. Interestingly, we had not even considered the aquarium, until a careful review of both visitors surveys indicated a strong desire on behalf of the public to have an aquarium. Further analysis revealed that there are no "major" aquariums between Baltimore and Orlando--a fact we had completely overlooked prior to this review. One interesting note relative to the aquarium is our desire to utilize this facility for special events - after hours, etc. This desire has been incorporated into the design, with a food preparation area and storage space for tables and chairs.

Over the years we have come to the realization that a zoo without reptiles is similar to the famous Wendy's line, "Where's the beef?" Except in our case it's, "Where's the snakes?" Therefore a major reptile exhibit is considered the most important component necessary for the success of Phase II. While the main emphasis on the reptile house will be reptiles of the world, a considerable amount of space has been set aside for South Carolina's unique reptile life.

We have also been criticized for not having a children's or petting zoo. This led to a series of staff discussions centering on the philosophy of such exhibits. Following a considerable amount of debate (actually "argument" would be a more accurate word) we decided to construct a small farm, allowing limited animal contact. (I think it is interesting to note that among the many components of the Master Plan, the farm has received the most attention by members of the County Councils.)

Ultimately, fine tuning of the Master Plan resulted in a project with a $6.35 million price tag.

Our sole remaining task was to then analyze the potential impact of the Master Plan on the Zoo's operating efficiency. For this, we employed the services of a financial consultant--Economic Research Associates of Los Angeles.

Specifically ERA made a ten-year financial forecast under two scenarios: a Base Case and the Master Base Case. The Base Case assumed the Zoo would stay in its present physical configuration. The Master Plan Case assumed that the Phase II expansion plan would be implemented during fiscal years 1987 and 1988.

The Base Case assumed:

(1) Attendance would escalate at two percent per year due to area population

growth only.

(2) All revenue and expense areas would be subject to an annual five percent inflation factor.

(3) Promotion expenses would have to increase more than inflation to sustain attendance.

(4) No growth in per capita spending (outside of inflation).

(5) No increase in the visitor length of stay.

Whereas the Master Plan Case assumed:

(1) Length of stay increased from 1.75 to 2.75 hours.

(2) 35 percent increase in attendance in conjunction with major exhibit openings and then a 20 percent sustained increase.

(3) All revenue and expense areas would be subject to an annual five percent inflation factor.

(4) Promotion expenses would be increased significantly to assure success of the expansion.

(5) Additional operating costs of new facilities were provided for.

(6) Per capita spending would increase an overall 52 percent at full implementation of the expansion.

I would like to go to the slides now so that I may summarize for you the results of the study.

Statement 1 - Planning Factors - Base Case

The statement presents the factors used to project the operating picture for the ten-year forecast period, assuming no zoo expansion.

This line represents attendance, reflecting a two percent growth factor, due to population growth in the Columbia area.

Our per capita visitor expenditures are shown on this line. They increase at an annual rate of five percent due to inflation. No growth beyond the inflation factor is projected.

These lines show the factors which were used to project expenses such as cost of goods sold, percentages for food and merchandise, and other items subject to the five percent inflationary factor.

Statement 2 - Planning Factors - Master Plan Case

The same factors as illustrated in Statement 1 are shown, reflecting the increased attendance due to the expansion project, along with increased visitor per capita expenditure (admissions, food and merchandise).

Increased operating expenses due to expansion have been included here.

Statement 3 - Food and Merchandise Operating Statements

This shows the comparison, in dollars, of the effects of expansion on the food and merchandise areas only. This indicates an additional net income of $1,840,000 from these two areas alone.

Statement 4 - Anticipated Savings in Operating Subsidies

This shows the overall effect on our income statement for the two scenerios. This format was included to show our county council members the savings in future operating support due to zoo expansion. That savings is projected to be just under $4 million.

This then is our justification for expansion - a $4 million saving to the tax-paying residents of Columbia during the next ten years.

You may be wondering, why spend $6 million to save $4 million? Remember, the 4$ million saving is over a ten-year period. Obviously a major expansion effort, which will take five years to complete, will affect the Zoo's financial status well beyond the ten year period. And, even though this has been a dollars and cents presentation, we must not forget that zoos are valuable in many other ways - cultural, educational. An expanded zoo will improve the quality of life for the citizens of Columbia.

Thank you.

Riverbanks Zoo Master Plan Implementation
Planning Factors
Alternative: Base Case (No Expansion)
(Thousands of Current Dollars)

STATEMENT 1

BASE CASE PLANNING FACTORS

MODEL INPUT FACTORS	Fiscal Year 1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Attendance (Escalator - 102.00%)	324	347	354	361	368	376	383	391	399	407	415	423
Inflation Factor	105.00%											
Per Capita Expenditures:												
Admission	1.71	1.80	1.89	1.98	2.08	2.18	2.29	2.41	2.53	2.65	2.79	2.92
Food	0.92	0.97	1.01	1.07	1.12	1.17	1.23	1.29	1.36	1.43	1.50	1.57
Merchandise	0.79	0.83	0.87	0.91	0.96	1.01	1.06	1.11	1.17	1.23	1.29	1.35
Total	3.42	3.60	3.77	3.96	4.16	4.36	4.58	4.81	5.05	5.31	5.57	5.85
Riverbanks Society (102.00% Escalator)*	142	145	148	151	154	157	160	163	166	170	173	177
State Contribution ($000)*	95	125	125	125	125	125	125	125	125	125	125	125
Operating Expense Factors												
Wage and Salary												
Administrative and Hourly ($000)	945	992	1042	1094	1149	1206	1266	1330	1396	1466	1539	1616
Concessions (% of Food/Merch. Revenue)	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%
Benefits and Taxes (% of above)	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%
Operating Supplies ($000)	146	153	161	169	177	186	196	205	216	226	238	250
Concessions COGS												
Food (% of Gross Sales)	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%	33.0%
Merchandise (% of Gross Sales)	46.0%	46.0%	46.0%	46.0%	46.0%	46.0%	46.0%	46.0%	46.0%	46.0%	46.0%	46.0%
Promotional ($000)	26	69	72	76	80	84	88	92	97	102	107	112
Maintenance and Utilities ($000)	360	378	397	417	438	459	482	507	532	558	586	616
General and Administrative($000)	65	68	72	75	79	83	87	91	96	101	106	111
Contingency ($000)	0	0	0	0	0	0	0	0	0	0	0	0

SOURCE: Economics Research Associates (October, 1984)
*Riverbanks Park Commission (Riverbanks Society and State Contribution estimates only)

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STATEMENT 2

Riverbanks Zoo Master Plan Implementation
Planning Factors
Alternative: Master Plan Case
(Thousands of Current Dollars)

MASTER PLAN CASE PLANNING FACTORS

MODEL INPUT FACTORS	Fiscal Year 1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Attendance (Escalator - 102.00%)	324	347	442	487	460	450	459	469	478	488	497	507
Inflation Factor	105.00%											
Per Capita Expenditures:												
Admission	1.71	1.80	2.12	2.46	2.58	2.71	2.85	2.99	3.14	3.30	3.46	3.63
Food	0.92	0.97	1.21	1.45	1.52	1.59	1.67	1.76	1.84	1.94	2.03	2.13
Merchandise	0.79	0.83	1.04	1.26	1.35	1.42	1.49	1.56	1.64	1.72	1.81	1.90
Total	3.42	3.60	4.37	5.19	5.45	5.72	6.01	6.31	6.62	6.95	7.30	7.67
Riverbanks Society (110.00% Escalator)*	142	145	148	163	179	197	216	238	262	288	317	348
State Contribution ($000)*	95	125	125	125	125	125	125	125	125	125	125	125
Operating Expense Factors												
Wage and Salary												
Administrative and Hourly ($000)	945	992	1129	1217	1278	1342	1409	1479	1553	1631	1712	1798
Concessions (% of Food/Merch. Revenue)	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%	23.0%
Benefits and Taxes (% of above)	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%
Operating Supplies ($000)	146	153	178	210	221	232	243	255	268	281	295	310
Concessions COGS												
Food (% of Gross Sales)	33.0%	33.0%	37.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Merchandise (% of Gross Sales)	46.0%	46.0%	48.0%	47.0%	47.0%	47.0%	47.0%	47.0%	47.0%	47.0%	47.0%	47.0%
Promotional ($000)	26	69	100	93	80	84	88	92	97	102	107	112
Maintenance and Utilities ($000)	360	378	432	481	505	530	557	585	614	645	677	711
General and Administrative($000)	65	68	78	82	86	90	95	100	105	110	115	121
Contingency ($000)	0	0	20	21	22	23	24	26	27	28	30	31

SOURCE: Economics Research Associates (October, 1984)
*Riverbanks Park Commission (Riverbanks Society and State Contribution estimates only)

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Riverbanks Zoo Master Plan Implementation
Food & Merchandise Operating Statements
Alternatives: Base & Master Plan Cases
(Thousands of Current Dollars)

STATEMENT 3

OPERATING STATEMENT - BASE CASE

FOOD AND MERCHANDISE:	Fiscal Year 1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Gross Sales	557	623	667	714	765	819	877	940	1006	1078	1154	1236
Cost of Goods Sold & Direct Supplies	205	243	260	279	299	319	342	367	393	420	450	483
Gross Profit	352	380	407	435	466	500	535	573	613	658	704	753
Salaries, Taxes & Benefits	159	166	177	190	204	218	234	251	268	288	309	329
NET INCOME - BASE CASE	193	214	230	245	262	282	301	322	345	370	395	424

OPERATING STATEMENT - MASTER PLAN CASE

FOOD AND MERCHANDISE:	Fiscal Year 1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
Gross Sales	557	623	997	1330	1318	1356	1452	1555	1666	1783	1910	2046
Cost of Goods Sold & Direct Supplies	205	243	420	540	536	551	590	632	677	724	777	831
Gross Profit	352	380	577	790	782	805	862	923	989	1059	1133	1215
Salaries, Taxes & Benefits	159	166	266	355	351	362	387	415	444	476	509	546
NET INCOME - MASTER PLAN CASE	193	214	311	435	431	443	475	508	545	583	624	669
INCREASED NET INCOME DUE TO EXPANSION			81	190	169	161	174	186	200	213	229	245
TOTAL INCREASED NET INCOME FOR TEN YEAR PERIOD	1848											

SOURCE: Economics Research Associates
October, 1984

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STATEMENT 4

Riverbanks Zoo Master Plan Implementation
Anticipated Savings of Operating Subsidies
Due To Zoo Expansion
(Thousands of Current Dollars)

BASE CASE - NO EXPANSION

	Fiscal Year 1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
REVENUES (Excluding County Funding)	1011	1107	1170	1235	1306	1383	1463	1550	1642	1743	1847	1962
EXPENSES	1693	1820	1911	2006	2106	2212	2322	2438	2560	2688	2823	2964
ANTICIPATED LEXINGTON/RICHLAND FUNDING	682	713	741	771	801	829	859	888	918	946	976	1002

MASTER PLAN CASE - ZOO EXPANDED

	Fiscal Year 1984-85	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
REVENUES (Excluding County Funding)	1011	1107	1519	1921	1923	1986	2124	2272	2433	2603	2787	2985
EXPENSES	1693	1820	2118	2299	2396	2516	2641	2773	2912	3058	3211	3371
ANTICIPATED LEXINGTON/RICHLAND FUNDING	682	713	599	378	473	530	517	501	479	455	424	385
ANTICIPATED SAVINGS OF OPERATING SUBSIDIES DUE TO ZOO EXPANSION			142	393	328	299	342	387	439	491	552	617

TOTAL SAVINGS OF ZOO OPERATING SUBSIDIES TO COUNTIES FOR TEN YEAR PERIOD 3990

SOURCE: Economics Research Associates (October, 1984)
Riverbanks Park Commission (Riverbanks Society and State Contribution estimates only)

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New Revenue Alternatives: How the New England Aquarium Started A Mail Order Business or Catalog Retailing: The Whys and Hows of the Mail Order Business

Beth Lyons, New England Aquarium, Supervisor, Direct Mail/Marketing Services

Background

In 1982, the New England Aquarium was the first museum in Boston to establish a marketing division. One of the division's major goals was to develop new revenue in addition to the already established areas of admissions, gift shop, snack bar, function rental, membership and whale watch sales. As different options were explored it became apparent that the Aquarium's gift shop business had the potential to support a well-defined merchandise catalog. However, the question was whether the economy could support another catalog in an ever-increasing competitive market.

In the late 1970's and the early 1980's catalogs became a popular way of reaching new customers. As American lifesyles changed during this decade, more women were working outside the home, time was scarce and many men and women found catalogs a convenient alternative to time-consuming shopping. In addition, more working women meant two-income families and more disposable income. To serve this market, the number of catalogs jumped from 4,000 in 1981 to 6,500 in 1984. "According to the Direct Marketing Association catalog sales are expected to increase in constant dollars, $28 billion dollars by 1985 in comparison to 1982 sales figures. By 1990, catalog purchases are expected to account for one of every three dollars spent in the United States." (Tom Chaflin. "Refining the Wish Book", Madison Avenue, April 1985, p. 91)

These statistics led us to believe there was a great potential for catalog marketing; however, we were aware also that not all of those 6500 catalogs had been successful. Merchandise selection, design, and format are significant factors that control the success of a catalog. Since thousands of catalogs exist merchandise duplication is common and considerable effort must be taken to assure that the offered products are unique, have a broad appeal, and will encourage repeat sales. While catalogs are increasing their share of the retail sales pie, there is no guarantee that every catalog will get a slice of that pie.

Because of stiff competition, catalog marketers rely heavily on reputation. Take, for instance, the Metropolitan Museum of Art and American Express. While both are well-known for their services and products they are not thought primarily as catalogers. If you were to receive a catalog from them, you would probably not question the quality of their goods and services. Companies such as L.L. Bean and Land's End had to earn their reputation. Given the New England Aquarium's reputation as one of the best aquatic institutions in the country, it was felt that the Aquarium would be able to begin a successful catalog business among its immediate audience.

Catalogs are a specialized business. They require lots of homework and considerable investment. The Aquarium put in the time and effort necessary and developed a five-year plan to help guide us through the difficult early years.

Our first catalog expectations were low: a 1% response with an average order of $35. With the results in our projections proved to be quite low. With a 1.5% response and an average order of $28 we adjusted our future projections accordingly.

Assuming that we were to mail 100,000 catalogs and expected a 2% response (determined through results of other institutions) for the second year (1985), we projected 2,000 orders. The average order size was anticipated to be $40.00. With cost of goods averaging 35% and figuring the production costs over $40,000 our net operating profit was expected to be low. And, this, does not take into consideration the cost of fulfillment which averages at approximately 12% of gross sales. While all this looks disappointing we were able to show that by the fifth year of operation the catalog would show a net operating profit of $141,000.

The "whys" of getting into the catalog business are history; the hows repeat themselves every year and I'd like to share the nine steps with you.

1. Choose A Design Team
2. Product Selection
3. Layout
4. Photography
5. Copy
6. Order Form
7. Printing
8. List Selection
9. Fulfillment

1. CHOOSING A DESIGN TEAM. Direct mail catalogs are specialty items and need design specialists. They require a specific knowledge of the market in order to produce a catalog that will encourage buying. Experiences with our 1984 catalog proved invaluable in this process. Using our advertising agency as a resource we soon learned that most agencies do not have a specific catalog design team; therefore, we looked to other established catalog businesses for recommendations. Interviewing designers became a major undertaking. While most catalog designers have the skills and experience to produce a good catalog it is important to find a designer with whom the client can work comfortably. The designer we chose became an invaluable partner.

Good photography is essential to catalog sales. In many instances, designers have already established relationships with photographers and can recommend the one best suited for the catalog's needs. Again, like the catalog designer, the catalog photographer is a specialist. A good catalog photographer should be able to take the merchandise and make it jump off the page. The shots need to be clean, clear and respresentive of the products.

A good printer can provide information that can decrease production costs. Printers are numerous. Many printers cannot produce the high quality required nor do many offer mailhouse or color separation services. In the Aquarium's case our budget was small; therefore, many printers did not see the potential of our catalog and many never even submitted quotes.

2. PRODUCT SELECTION. A catalog is nothing without good products and product selection is time consuming and tedious. A good buyer and considerable research are necessary to avoid duplicating other catalogs. Our first catalog was an excellent test. We were able to determine which of the 100 products listed were good candidates for future consideration.

Most of the products sold in the 1984 catalog fell into two categories: children's and unusual gifts. Based on this and on the fact that we are a family-oriented institution, products selected for our 1985 catalog were categorized into eight different sections which played to our market: children's, adults, summer items, penguin merchandise, holiday ornaments, and oriental merchandise that reflects our new exhibit. While we cut the number of products significantly from 100 items in 1984 to 70 items in 1985, we felt that our 1985 selection had a broader appeal and would target our audience appropriately. Prices range from $5.00 to $300.00 and the merchandise reflects the high quality that has come to be associated with the Aquarium. As important as the selection of the products is the pricing. Many items allow for a higher mark-up, while others can easily be over-priced and pricing is a key consideration to achieve the average order size necessary for your financial goals.

3. LAYOUT. Layout and design must conform with the traditional rules of catalog marketing. They must be simple, direct and provide a pattern for the eye to follow.

Using a standard digest size for our 1985 catalog (odd sizes waste paper which increases production costs) the artist sought to develop a style that would best represent our institution. The catalog needed a personality, one that could stand above the rest. It should be fun and entertaining to look at, its appeal should capture the attention of the young family and mature adult. The cover must exemplify the mood of the catalog.

4. PHOTOGRAPHY. The number of shots determines the number of days required to shoot the catalog and the price. Although our 1984 catalog had only six photographs, the time involved was as much as taking sixty studio shots. Moving equipment and setting the stage was time consuming and, because photographers charge on a daily rate, the cost was extremely high. While using props and models may be a good idea, it can increase the cost of the catalog.

5. COPY. Copy has to be short and informative. It must mention the benefits of the product. Too much copy can be tiring, too little copy may not provide enough information. The copy must fit the given space and be easily identifiable with the photograph. Remember copy is the salesperson in your catalog.

6. ORDER FORM. A catalog will not be successful unless the order form is simple, direct and clean. It should take no more than 2 minutes to place an order. The order form provides a great opportunity to test merchandise, as well as offering impulse merchandise, and it must reinforce the feeling that the merchandise will arrive without delay or confusion. Charge cards are an additional way of encouraging potential buyers to purchase from the catalog. Charge cards may add to administrative costs but cards have been known to account for more than 50% of all catalog sales. In addition to charges, increased sales can be encouraged with the use of an 800 number. The more numerous and easy order options offered to a potential customer, the better the chance for an order.

7. PRINTING. If every step to producing the catalog has been executed properly the printing will flow easily but just as poor color separations can ruin a catalog so can poor paper stock. A knowlegeable printer is key to guiding the catalog marketer.

8. LIST SELECTION. The best mailing list is your own list of prospective customers and while our members respond poorly to catalog mailings, we have obtained a list of prospective buyers through our museum shop. In addition to a house list, thousands of lists are available for purchase. List brokers are available to help in the list selection. Before recommendations can be made, the broker must know the intended audience for your mailing. In comparing lists you should always keep in mind the objective of the piece, examine the list description, the source, and when it was most recently updated. Testing a series of lists in 1984 from upscale, household item catalogs in the New England area provided the basis for our 1985 list selection. In 1985 eight lists in addition to the successful 1984 lists were choosen for testing. Lists never used before were purchased in moderation and tracked carefully.

9. FULFILLMENT. Your catalog can only be successful if you can keep 8% of all previous customers; this must be accomplished through good order fulfillment. In 1984, order fulfillment posed no apparent problem since the quantities were small (20,000), however, the increased quantity of a 100,000 piece mailing made it impossibleto fill orders inhouse.

Our first catalog experience taught many lessons for those considering the catalog business. First, be prepared to make a long term investment. Second, beware of costly, or unusual designs. Seek out expert advice from those who have had considerable catalog experience. Third, seek out alternatives to building your data base. Remember catalog work is quantity work. Be sure to get the best possible price, and look for ways to build volume. And finally, remember just because the production is complete a catalog is a never ending process.

BACHELOR HERDS AND STALLION DEPOTS : A NEW APPROACH TO AN OLD PROBLEM

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Asian wild horses, Equus przewalskii, are represented in captivity by about 600 animals at some 70 institutions in three geographic groupings: Europe, the Soviet Union and North America (Volf, 1984). Because there has been no confirmed sighting of them for several decades (Bannikov and Lobanov, 1980) in any part of their last known refuge -- high steppe habitat of southwest Dzungaria and the Gobi Altai, Mongolian People's Republic -- the species is considered extinct (but see IUCN Bull. 12:43, 1981). The extant population of this species traces its wild ancestry to eleven animals captured at the turn of the century and a single mare brought out in 1947 (Mohr, 1971; Bannikov and Lobanov, 1980). This places the burden of species survival and integrity upon managers of the vestigial captive population.

Although captive propagation of the Asian wild horse for over 80 years has maintained its existence in spite of the decline and apparent extinction of the wild population, there is clear cause for concern (IUCN/CBSG Przewalski Horse Committee Report, 1982). In particular, careful attention must be given to future genetic (Bouman, 1977; Bouman and Bos, 1979; Ryder and Wedemeyer, 1982; and reviewed in IUCN/CBSG Przewalski Horse Committee Report, 1982) and demographic (Foose, 1980) management strategies designed to increase numbers of the captive population. One problem with captive population expansion is that space and resources in zoos are limited in relation to the increasing number of endangered species. More specifically, in harem living species (one male:multiple females) such as Asian wild horses, surplus stallions beyond those needed in breeding units typically are managed as solitary animals, and occasionally as pairs or trios, because mature stallions are extremely combative towards one another. This restricts aggressive implementation of optimal breeding strategies that seek to reduce inbreeding coefficients, equalize founder representation and/or promote maximal genetic diversity as identified above. Here we present a management program on how to resolve this space dilemma.

The Asian wild horse was identified by the Minnesota Zoo as a species for intensive management and propagation efforts. To provide a broad genetic base for the foundation of the Asian wild horse program 2.6 horses, from ten months to two years of age, were imported from Great Britain; 1.3 from the London Zoological Society, and 1.3 from

Marwell Zoological Park. Our breeding strategy was designed to reduce inbreeding coefficients in successive offspring and to increase the effective population size by rotating different stallions into each mare band.

The intentional use of different stallions on a regular basis required the management of stallions beyond those needed in the breeding units. The idea was not new. At the first meeting of Asian wild horse owners, which evolved into the propagation group (SSP) for the species, held in San Diego, November 1979, the establishment of stallion depots was discussed (see IUCN/CBSG Przewalski Horse Committee Report, 1982). Depots were defined as facilities where collections of bachelor (or all male) herds were to be kept and stallions made available for breeding exchange.

The Minnesota Zoo discussed the formation of a bachelor herd as early as 1979, but because of historical reproductive rates, surplus horses were not anticipated as a problem for a number of years. However, our two breeding units demonstrated exceptional fecundity compared to the rest of the U.S. Asian wild horse population during the same time frame (Figure 1). Twenty-one foals have been born at the MZG since 1980 and of these, nineteen (90%) are still alive (Table 1).

As a result of rapid expansion, and the inability of other institutions to absorb surplus stallions, the Minnesota Zoo rapidly developed a space crisis. Extra stallions were kept in small groups or as solitary individuals occupying up to four separate spaces. To absorb another four colts from the breeding units we needed to alter our stallion management program. This provided an opportunity to explore the feasibility of developing a bachelor herd. Thus, even though bachelor herds and stallion depots were intended to be a pivotal part of the long term management of the species, there has been no attempt to establish groups of stallions (see Berry, 1985) nor were there any guidelines for implementing such a program.

The optimal solution to the stallion space problem was to manage the eight identified surplus males together. These stallions were owned by the Minnesota Zoo, New York Zoological Society, the Brookfield Zoo and the National Zoo, so permission was received from each institution prior to our efforts at forming a bachelor herd. Stallion identifications are presented in Table 2 and the chronological order of the stallion introduction to form a bachelor herd is presented in Table 3. The result of our efforts is that we have managed, for the past year, all eight stallions in an unsheltered outdoor enclosure of about five acres of mixed woodland/open pasture.

During the Fall of 1984 a 10 week study of 63 hours of direct observations was conducted on social interactions among the eight different aged horses. Individual horses were recognized by size, color and unique markings. Aggressive interactions were noted on an all-occurrence basis, including identity of the actor, the recipient and outcome of the interaction. Every two minutes, spatial affinities were noted to allow assessment of optimal band size and composition.

The preliminary results suggest that:

1. Among the eight stallions a near linear dominance hierarchy was evident, whether aggressive only interactions were used as a criteria of social dominance or whether subtle or nonaggressive supplants were used as a criteria (Tilson, et al., 1985).

2. Social dominance was not based on age (the two oldest stallions ranked second and third) nor was it based on size. Rather, dominance was based on individual aggressiveness.

3. The most prevalent association was among the most dominant stallion and the four youngest and least dominant stallions, accounting for nearly one-half of the groupings (Figure 2).

4. The three middle ranked stallions were kept away from the above group by the dominant stallion.

5. The suggestion that youngsters find protection from harassment by associating with a dominant stallion (Walther, et al., 1983) seems supported. The frequency and direction of aggressive and passive interactions among the eight stallions supports this premise. Further support is gained through observed social groupings and spatial proximity to each other (see Tilson, et al., 1985).

It should be noted that just as all attempts at the formation of breeding units are not successful, all attempts at the formation of similar stallion groups may not succeed. Behavioral traits of some stallions may make them unsuitable for stallion herd management. Compatible individuals will be identified only as more attempts are made.

We believe the formation of this bachelor herd is a critical first step towards attaining the established goals for long term stallion management. From the experience and knowledge we have gained through the introductions described here, mixed-age bachelor herds appear to be an attainable objective for this species which provides an option for the interim maintenance of stallions not in reproductive groups.

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Table 1: Asian wild horse births at the Minnesota Zoological Garden.

MZG Accession Number	Sex	Date of Birth	Studbook Number	Breeder Number	Sire S.B. Number	Dam S.B. Number	Date of Death
1746	M	02V80	886	MN1	615	668	
1868	M	01VI80	909	MN2	615	700	
2392	F	04IV81	948	MN3	688	697	
2405	F	18IV81	952	MN4	688	694	
2920	F	11IV82	1028	MN5	688	694	
2935	F	23IV82	1035	MN6	688	697	
3106	M	15VII82	1079	MN7	615	700	
3117	F	25VII82	1082	MN8	615	668	[1] 05VIII82
3289	M	11IV83	1109	MN9	368	697	
3299	M	22V83	1111	MN10	368	694	
3366	F	15V83	1125	MN11	368	948	
3499	F	20VI83	1155	MN12	368	952	
3548	M	07VII83	1164	MN13	368	700	
3561	F	10VII83	1167	MN14	718	668	
3659	M	16IX83	1185	MN15	718	667	
3799	M	10IX84	N/A	MN16	368	697	
3820	M	08V84	N/A	MN17	368	694	
3990	F	26VI84	N/A	MN18	368	700	
4107	M	06IX84	N/A	MN19	688	667	[2] 19IX84
4108	F	09IX84	N/A	MN20	688	668	
4298	F	28III85	N/A	MN21	368	697	

1. Cause of death was intussusception; 2. Cause of death was elective euthanasia for congenital defect (cleft plate).

Table 2: Identity of Asian wild horses mixed to create a bachelor herd.

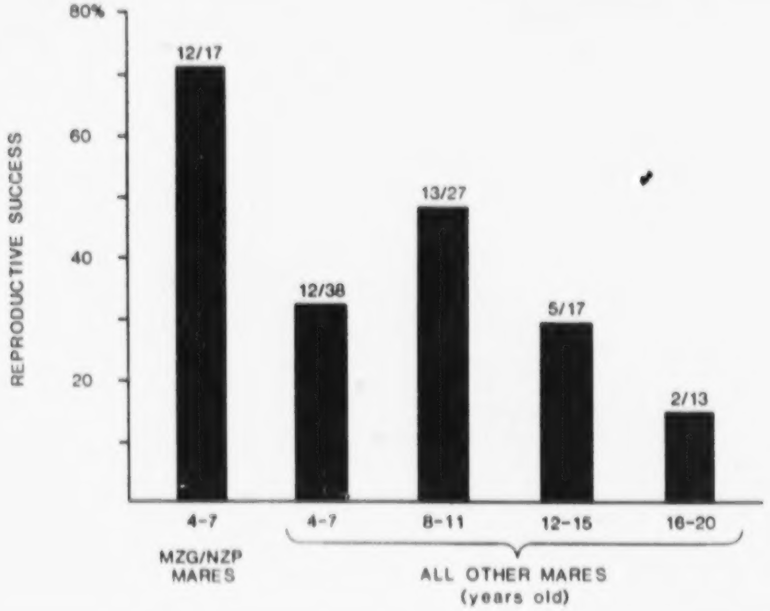
MZG #	SB #	Name	Date of Birth	Owner
592	615	Kuporovitch	born 10 May '75	National Zoo
1094	626	Kentei	born 02 June '75	NY Zoological Society
1746	886	JT	born 02 May '80	National Zoo
1868	909	Adolph	born 01 June '80	Minnesota Zoo
3289	1109	n/a (S)	born 11 April '83	Brookfield Zoo
3299	1111	n/a (1)	born 22 April '83	Minnesota Zoo
3548	1164	n/a (H7)	born 07 July '83	Minnesota Zoo
3659	1185	n/a (S7)	born 16 Sept. '83	Minnesota Zoo

Letters and numerals in parentheses refer to identity conferred for collection of behavioral data.

Table 3: Chronological events of bachelor herd formation.

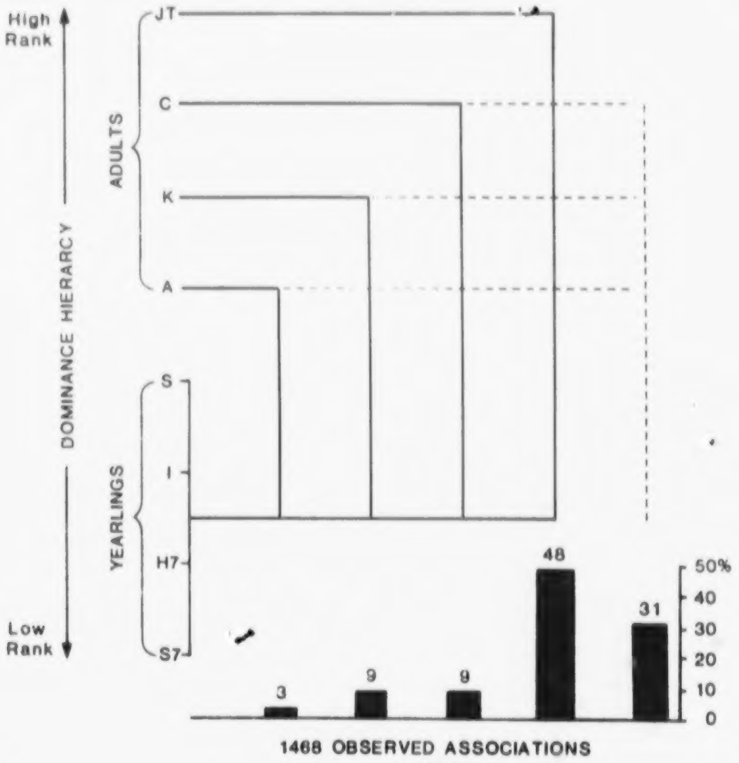
1-3 July 81	Colts 1746 and 1868 were separated from their respective breeding herds and mixed with one another.
8 January 82	Stallion 592 was introduced to yearlings 1746 and 1868 for a brief time in a 10 acre exhibit pasture. The colts were separated from the stallion due to the intensity of the aggression and cold weather conditions.
10 March 83	The stallion 1094 was introduced to 1746 and 1868 in a 5 acre area off exhibit. The trio proved compatible and the relative level of aggression was not intense.
20 March 84	The colts 3289, 3299 and 3548 were separated from their breeding herd and housed together in off exhibit pen.
25 April 84	The colts 3289, 3299 and 3548 were transferred to a 10 acre exhibit to gain familiarity with the area.
26 April 84	The stallion 592 was introduced to the colts 3289, 3299 and 3548 in the area occupied by the colts. This group demonstrated compatibility with very low aggression displayed by the stallion 592 and complete submission displayed by the colts.
3 May 84	The stallion herd of seven formed by introducing stallions 1094, 1746 and 1868 to the large area occupied by 592, 3289, 3299 and 3548 for the previous week. Serious aggression was displayed by the three oldest stallions 592, 1094 and 1746. By the end of the day, stallion 1746 was clearly the dominant stallion; 1094 and 592 had formed an association apart from the other horses; and 1868, 3289, 3299 and 3548 were essentially not involved in the contest for dominance.
15 May 84	After allowing the herd of seven males nearly two weeks to establish their relationships in the large exhibit area, the entire group was transferred to the 5 acre area previously occupied by 1094, 1746 and 1868.
9 September 84	The colt 3659 was isolated from his breeding herd.
18 September 84	The colt 3659 was introduced to the bachelor herd in the exhibit pasture. He was immediately accepted by the dominant stallion and three other colts, and tolerated by the other stallions. These introductions complete the present management program in developing a bachelor herd at the Minnesota Zoo.

Figure 1: Comparative fecundity of Asian wild horse mares in the North American population.



Fecundity of Asian wild horse mares in U.S. population. Mares of MZG/NZP population are represented only in age class 4-7 and are graphed separately. All other mares are represented collectively for each age class.

Figure 2: Social dominance matrix of eight Asian wild horse stallions and observed spatial associations (bar graph). The most prevalent association was between stallion JT and the four yearlings (48%).



Spider Monkey Conservation Status in U.S. Zoos

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In March 1984, the World Wildlife Fund - U.S. Primate Program began a survey to assess the status of spider monkeys (*Ateles* spp.) in captivity (Konstant *et al*., 1984). Field reports published over the past decade describe declining populations and local extinctions of spider monkeys in many parts of Central and South America (e.g., Bernstein *et al*., 1976; Mittermeier and Coimbra-Filho, 1977; Thorington and Heltne, 1976). The principal causes of decline are habitat destruction, hunting for food, and live capture to supply the pet trade. In captivity, spider monkeys are relatively common, especially in comparison to the other genera of large Neotropical primates, *Lagothrix* and *Alouatta*. However, the best evidence available prior to this survey indicated that current management practices could not be expected to sustain three of the four recognized species of *Ateles* (Stevenson, 1983).

Based upon annual reports by ISIS and IZY it is clear that a number of zoos experience some difficulty in determining precisely which species of *Ateles* they maintain and that hybrids of little conservation value are commonly being produced. In addition, it seems likely to us that a percentage of the specimens reported were misidentified and that an even larger percentage of the total captive population was not being reported at all.

A presentation made to the AAZPA in September 1984 (Konstant *et al*., 1984) reviewed the four species and sixteen subspecies of *Ateles* currently recognized by the zoological community. It was intended not only to aid zoo personnel in making accurate identifications of their specimens, but also to increase the existing level of interest in this important Neotropical genus.

Several facts became evident early in the survey and confirmed our earlier suspicions. First, a significant number of respondents to our questionnaire indicated that they were not entirely confident in the identifications that they had made, especially at the subspecific level. Secondly, based upon photographs and slides provided with some of the questionnaires, we found that certain taxa were routinely being confused (e.g., *Ateles fusciceps robustus* was more often identified as *Ateles paniscus chamek*, and *Ateles* belzebuth hybridus was often mistaken for an Ateles geoffroyi). Thirdly, zoos were apparently not acting effectively to avoid the production of hybrids or to segregate obviously different specimens within their collections.

In January 1985, a preliminary report on this Ateles survey was published in the first issue of Primate Conservation, the newsletter/journal of the IUCN/SSC Primate Specialist Group (Konstant et al., 1985). Providing an illustrated color guide to the recognized species and subspecies and corresponding lists of institutions which exhibit and breed each of them, the report is already being used by zoos worldwide as an aid to captive management of spider monkeys. New information continues to arrive and this paper presents an update to the earlier report.

The following section describes, to the best of our knowledge, the current captive distributions of several Ateles subspecies to which we feel AAZPA institutions should give particular attention. Data is also provided on foreign collections, as cooperative international programs may very well be important to the conservation of some taxa.

Ateles belzebuth hybridus (Fig. 1)

This subspecies from northern Colombia and Venezuela appears to be rare in North American collections, yet more common than either of its conspecifics, Ateles belzebuth belzebuth (one female confirmed in one private collection) and Ateles belzebuth marginatus (none reported). It is also not very common in foreign collections and should be considered a priority subspecies by zoos which maintain it (Table 1).

Ateles fusciceps robustus (Fig. 2)

This all-black spider monkey from northwestern Colombia and eastern Panama is more often reported as the Amazonian black spider monkey Ateles paniscus chamek. Prior to the WWF - U.S. survey, only ten individuals from the National Zoo and the Utica Zoo were known from ISIS records. At this time, we can now confirm the existence of at least 50 specimens maintained in 18 different zoos worldwide (Table 2). It is likely that this number will grow significantly as more zoos respond to our survey.

Ateles geoffroyi geoffroyi (Fig. 3)

This Central American subspecies is restricted to

Nicaragua, but its range is apparently contiguous with that of a similarly colored subspecies, Ateles geoffroyi frontatus, which extends southward into northwestern Costa Rica (Kellogg and Goldman, 1944). These lighter-colored Central American spider monkeys are very common in North American collections and there is every reason to believe that their captive populations are sustainable (Table 3). The problem that exists is a taxonomic one, i.e., whether they are indeed distinct subspecies. At present it is difficult for zoologists to distinguish between them. Future cytogenetic or isoenzyme studies, along with new information expected from field studies on wild populations may help to answer the above question.

Ateles geoffroyi panamensis (Fig. 4)

This subspecies is distinguished from the other Central American spider monkeys by the significant amount of red coloration on its body, particularly the abdomen. It is found throughout western Panama and its range extends northward into southwestern Costa Rica. Due to extensive agricultural expansion and livestock production in Panama, this subspecies should be considered endangered in the wild.

In captivity, we can confirm the existence of Ateles geoffroyi panamensis in only a handful of collections (Table 4). However, given the large number of Ateles geoffroyi in zoos that are reported only to the species level, it is not unlikely that more unidentified individuals exist. Every effort should be made to produce as accurate a captive inventory of this subspecies as possible.

Ateles geoffroyi vellerosus (Fig. 5)

This is the northernmost of the Ateles, occurring in Mexico, Guatemala, El Salvador and Honduras. A dark dorsal surface, head and limbs that contrast with a light abdomen distinguish this subspecies from those which occur from Nicaragua south through Panama. It is not easily distinguished, however, from Ateles geoffroyi pan (central Guatemala) and Ateles geoffroyi yucatanensis (Mexican Yucatan and Belize). It may be that they represent a single subspecies.

Specimens which the authors would call Ateles geoffroyi vellerosus occur in several U.S. zoos, but can also be found in a number of Central American, European and Australian institutions (Table 5).

Remaining Ateles Taxa

The status of several spider monkey subspecies is questionable, and the genus Ateles is in need of taxonomic review in addition to that done by Kellogg and Goldman

(1944). Although preliminary efforts are being made in this direction, it will be a number of years before any real headway can be made. In the meantime, zoos can expect to continue experiencing difficulties in distinguishing between certain species and subspecies, especially where there is evidence of hybridization. The increased attention that is now being paid to this genus will hopefully lead to better segregation of presumably different taxa and a determined effort to avoid the production of hybrids in the future.

It is likely that taxonomic review will reduce the present number of recognized *Ateles* subspecies (16). Zoos in North America can contribute to the conservation of a handful of these through captive breeding, but only if they act through coordinated management plans.

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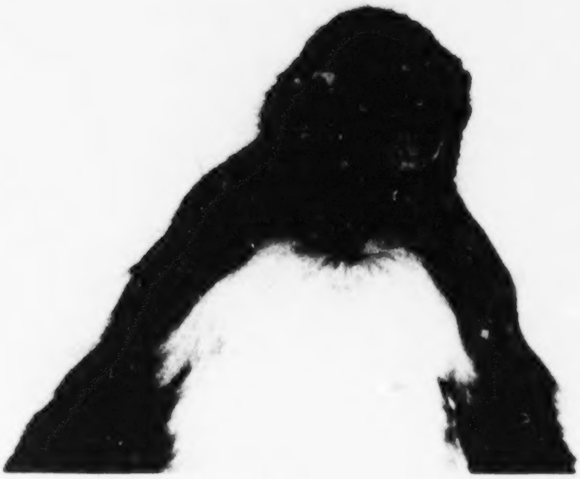

Fig. 1: Captive female Ateles belzebuth hybridus from the Akron Zoo, Ohio (photo courtesy of Diane C. M. Forsyth).

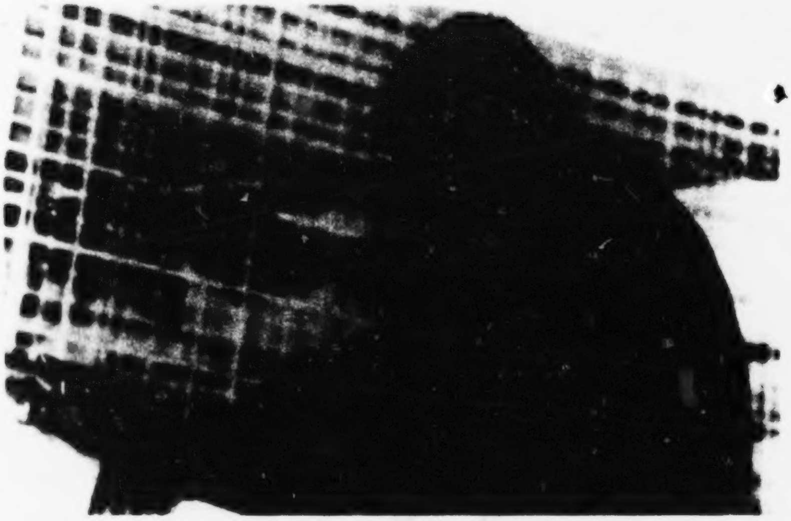

Fig. 2: Male Ateles fusciceps robustus from the Basel Zoo, Switzerland (photo courtesy of Dr. Dieter Rüedi).

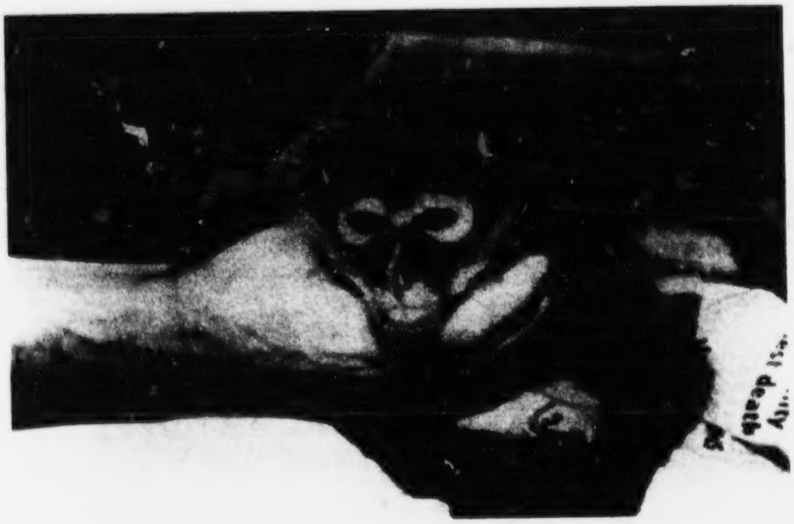

Fig. 3: *Ateles geoffroyi geoffroyi* undergoing routine examination at the Staten Island Zoo, New York (photo courtesy of William H. Summerville).

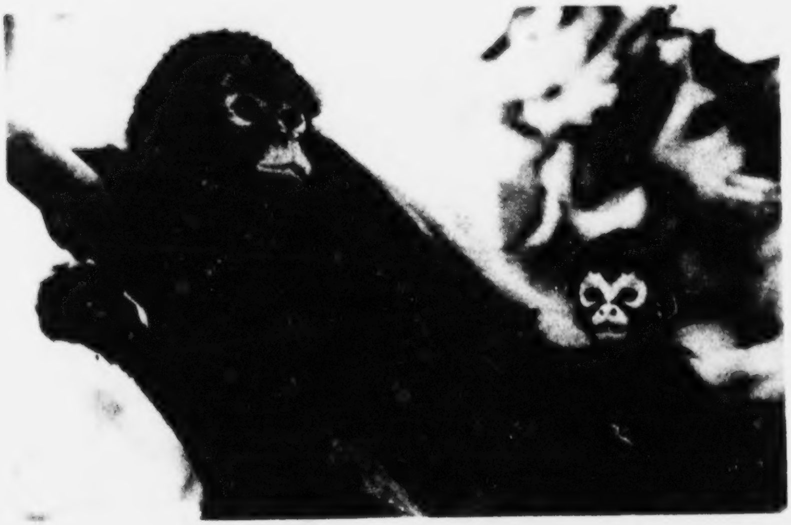

Fig. 4: Mother and infant *Ateles geoffroyi panamensis* from Barro Colorado Island, Panama (photo by R. A. Mittermeier).

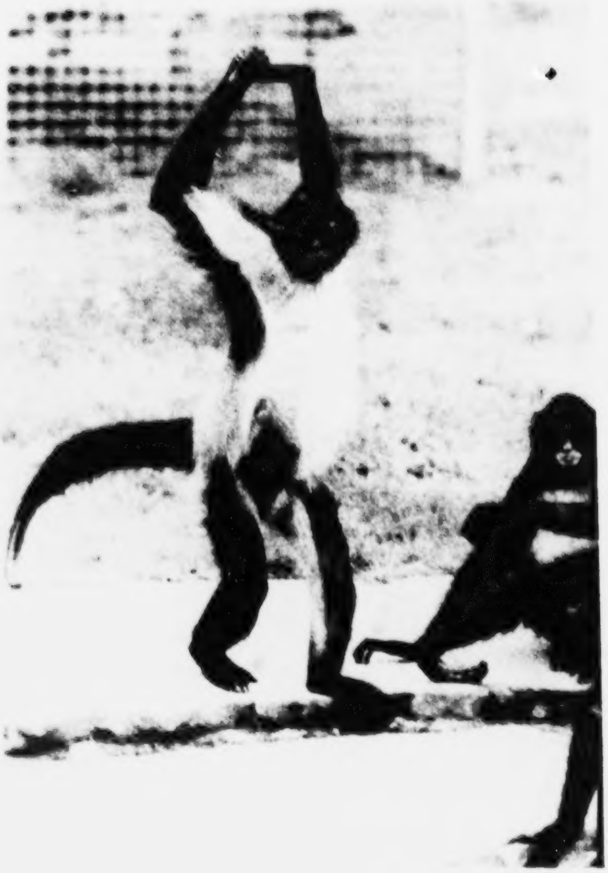

Fig. 5: Ateles geoffroyi vellerosus from the Frankfurt Zoo, West Germany (photo courtesy of Dr. Richard Faust).

Table 1: *Ateles belzebuth hybridus* in Captivity

Region	Institution	Collection
North America	Akron Zoo (Diane Forsyth)*	0/1
	Assiniboine Park Manitoba, Canada (Clive Roots)	1/4/1
	Atlanta Zoo (?) (Lorraine Perkins)	0/1
	Louisiana Purchase (Ken Kaemmerer)	1/0
	Sedgewick County Zoo (Mark Reed)	1/0
South America	Emperor Valley Zoo Trinidad (Hans Boos)	3/3
Europe	Kilverstone Thetford, England (Lord Fisher)	0/2
	Parque Zoologique Mulhouse, France (J. M. Lernould)	0/1
	Parc Zoologico Barcelona, Spain (RAM, pers. ob.)	0/1
	Silesian Zoo Katowice, Poland (Z. Zielinski)	1/1

*: Name of individual at institution providing information to WWF-U.S.

Table 2: *Ateles fusciceps robustus* in Captivity

Region	Institution	Collection
North America	Baltimore Zoo (?) (Sandra Kempske)	2/2/1
	CEPEPE Canal Zone, Panama (Nathan Gale)	?
	Cleveland Metroparks (Donald Kuenzer)	1/5
	Erie Zoo (Cynthia Krieder)	0/1
	Fort Rickey Game Farm (Len Cross)	?
	Glen Oak Zoo (Larry Sorel)	0/1
	Henry Doorly Zoo (?) (Lee Simmoms)	1/3/2
	John Ball Zoo (Chuck Wikenhauser)	0/1
	Kings Island (Kathy Hiner)	0/1
	Louisiana Purchase (Ken Kaemmerer)	0/1
	Monkey Jungle (RAM, pers. ob.)	2/7
	National Zoo (Lisa Stevens)	4/3
	Sedgewick County Zoo (Mark Reed)	0/1
	Toledo Zoo (Glenous Favata)	1/0
	Utica Zoo (Steven Matthews)	1/2

Table 2 (continued)

Europe	Apenheul (?) Apeldoorn, Netherlands (Tine Griede)	5 (?/?)
	Basel Zoo Basel, Switzerland (Dieter Ruedi)	1/3
	Budapest Zoo Budapest, Hungary (Mihaly Seres)	0/3
	Parque Zoologique Mulhouse, France (J. M. Lernould)	3/3
Australia	Taronga Zoo New South Wales (Carolyn Halligan)	0/1

Table 3: *Ateles geoffroyi geoffroyi* in Captivity

Region	Institution	Collection
North America	Beardsley Park Zoo (Gregg Dancho)	1/2/1
	Birmingham Zoo (Bob Truett)	?
	Brookfield Zoo (ISIS)	0/1
	Buffalo Zoo (Jerry Acquilina)	1/2/1
	Dallas Zoo (John Wortman)	1/8/1
	Dreher Park Zoo (Sally Lieb)	0/1
	Erie Zoo (Cynthia Krieder)	1/3
	Glen Oak Zoo (Larry Sorel)	1/2
	Greater Baton Rouge (Diane Stewart)	1/1
	Henry Doorly Zoo (RAM, pers. ob.)	1/5/1
	Jacksonville Zoo (John Meyer)	0/4
	Kings Island (Kathy Hiner)	1/4
	Lafayette Park Zoo (Connie Sweet)	5/1/1
	Little Rock Zoo (Robert Cooper)	1/7
	Los Angeles Zoo (RAM, WRK , pers. ob.)	?
	Montgomery Zoo (Charles Clift)	3/10

Table 3 (continued)

	Roeding Park Zoo (Paul Chaffee)	0/5
	San Diego WAP (Diane Brockman)	?
	Sedgewick County Zoo (Mark Reed)	0/3
	Seneca Park Zoo (Dan Michalowski)	1/1
	St. Louis Zoo (Roger Birkel)	1/4
	Staten Island Zoo (William Summerville)	1/5
Europe	Kobenhavns Zoo Copenhagen, Denmark (Bengt Holst)	2/5
	Welsh Mountain Zoo North Wales, UK (Nick Jackson)	0/2
Australasia	Auckland Zoo New Zealand (D. Folwell)	6/15
	Royal Melbourne Zoo Victoria, Australia (Graeme George)	2/2
	Taronga Zoo New South Wales, Aus. (Carolyn Halligan)	3/9

Table 4: *Ateles geoffroyi panamensis* in Captivity

Region	Institution	Collection
North America	CEPEPE Canal Zone, Panama (Nathan Gale)	?
	Lincoln Park Zoo (Dennis Meritt)	1/2
	Toledo Zoo (?) (Glenous Favata)	0/1
Asia	Nagoya Higashiyama Zoo Nagoya, Japan (Takeshi Asai)	2/3

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Table 5: *Ateles geoffroyi vellerosus* in Captivity

Region	Institution	Collection
North America	Club Auto Safari Guatemala (Lorena Calvo)	10/6/2 (?)
	Parque La Aurora Guatemala City Guatemala (Lorena Calvo)	5 (?/?)
	Primarily Primates (Wally Swett)	0/1 +
	San Francisco Zoo (RAM, WRK, pers. ob.)	?
	Turtle Back Zoo (Mike Kendall)	0/1
	Tuxtla Gutierrez Zoo Chiapas, Mexico (Alfredo Cuaron)	1/6
Europe	Frankfurt Zoo Frankfurt, Germany (Richard Faust)	3/6
	London Zoo London, England (SDN, pers. ob.)	1/1
Australasia	Orana Park Wildlife Christchurch, NZ (Paul Garland)	2/5

The Cheetah Program at the Columbus Zoo: What's Worked & What Hasn't

Management & Husbandry of the Columbus Zoo's Cheetah Collection

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-William L. Cupps, Head Keeper
Columbus Zoo

HISTORY

Cheetahs (Acinonyx jubatus) have been in the Columbus Zoo collection off and on since 1955. In January 1979 the zoo received and later purchased 1.1 cheetahs from the Ringling Brothers Circus. "Kissy" and "Kamaty" were siblings approximately two years three months of age. Already present in the Columbus Zoo cheetah collection were "King," a wild-caught male approximately 11 years of age, and "Grandma," a female approximately 13 years of age. With the acquisition of Kissy and Kamaty, the zoo began to concentrate on breeding the endangered cheetah.

The grass in the cheetah yard was allowed to grow, a few dead trees were cut and left to lay, large rocks were put in place, and a concrete den was built and covered with dirt to form a mound. All of this was done to provide a more natural area with observation points for the cats to climb on and mark with feces as they do in the wild.

Adjacent to the yard is a stone building with individual indoor pens used for winter housing and for isolating cheetahs. A 5' x 4' x 4' box was built for one of the inside cages to be used as a cubbing box (according to specifications supplied by Frank Gilbert, Cheetahs Unlimited).

Males were separated from the females for periods of time--ranging from two weeks to a few months--and then reintroduced.

On 24 October, 1979, 1.5 cubs were born to Kissy and Kamaty. Of these six cubs, only 0.2 survived beyond infancy. A second litter was born on 11 February, 1981 (1.4 cubs to King and Kissy with 0.2 surviving). Surviving cubs of both litters were hand raised. After a third litter was born on 27 August, 1981 (2.3 cubs to King and Kissy with none surviving), a new cubbing den was built. This den was separated from the rest of the pens by a solid wall, and a one-way glass window was installed for monitoring the cubs' health without disturbing maternal care.

When the next litter was born on 28 July, 1982, to Kissy and "Shamba" (Shamba was a three-year-old male acquired from the Cincinnati Zoo in a trade for one of our cubs), it was obvious that the new den with its remote observation capabilities was an improvement. One healthy male was born and another cub stillborn (sex unknown, mother consumed it). This birth was captured on videotape with the aid of the one-way window, and the maternal care and baby's health were both observed and filmed. At ten days of age, the cub appeared weak and was pulled to be hand raised in the zoo nursery. The cub, dubbed "Duma," had congested lungs but quickly recovered.

In 1982 the Working Association for the Zoo (WAZOO) raised the funds to build a second cheetah yard on the east side of the zoo. The addition of this second yard provided extra space for the zoo's growing cheetah collection and an area to easily separate the males from the females before the reintroduction that often leads to breeding.

Kissy's next three deliveries were complicated and the cubs (0.1.2), (0.1), (0.1) were taken by caesarean section. All perished within 48 hours. However, Kissy's offspring from her first and second litters, "Columbia" and "Sukari," concurrently were producing and caring for healthy babies.

Sukari and "Saba" (a nine-year-old captive-born male purchased from Cheetahs Unlimited) paired to produce 0.4 cubs on 9 October, 1983. These cubs were partial third-generation captive born and the second generation born at the Columbus Zoo. This litter was a major breakthrough for the zoo. It was the first litter from a female other than Kissy and the first mother-raised litter. It should also be noted that Sukari was hand raised in the zoo's nursery. She had retained affection toward her keepers that began in the nursery and allowed a few keepers to enter the cubbing den daily to monitor the cubs' growth and health. To date, all four cheetahs are still alive, and two have been traded to other zoos (Baton Rouge and San Diego Wild Animal Park) for 1.1 cubs with different bloodlines.

On 20 July, 1984, Columbia gave birth to 2.3 cubs fathered by Saba. Columbia is also an offspring of Kissy and hand raised in the nursery. She too allowed zoo staff to enter the cubbing area daily to handle her cubs, weighing them and checking for complications. Four of these cubs still survive. One male, the runt, died at approximately four months of age due to congenital defects.

By early 1983, several factors seemed to be firmly in place regarding the Columbus cheetah breeding program. First, much had been learned regarding husbandry and techniques for stimulating breeding. Two yards provided space and flexibility for incorporating many of the things learned. And, finally, Sukari and Columbia were showing signs of breeding, thus there was potential for more cubs for trading. It was time to look to diversifying the bloodlines of the collection.

Shopping for suitable animals available for purchase, loan, or trade began. The first new animal acquired was "Dara," a five-year-old female brought in on breeding loan from the Kansas City Zoo in November of 1983. In April 1984, one-year-old "Spicy," was traded for one of Sukari's cubs via the Baton Rouge Zoo from Whipsnade in England. In November 1984, we received "Charlie," a two-year-old male traded with San Diego Wild Animal Park for one of Sukari's cubs. Early in 1985 the zoo purchased "Pharaoh," a twelve-year-old male, from Lion Country Safari in California. Two wild-caught females, ages eleven and twelve, from the Metro Toronto Zoo are due to arrive any day on a breeding loan. These last three cats are wild-caught and bring with them new bloodlines. The Columbus Zoo's three-year-old male, Duma, will be leaving this fall for the San Diego Wild Animal Park to fulfill another breeding loan. Three of the 1982-83 cubs are reaching breeding age and are ready for new non-related mates. Thus, the plan for establishing broader bloodlines is progressing well.

The zoo marked its tenth litter in just five years on 17 October, 1984, with the birth of 2.2 cubs to Sukari and Saba. Sukari cared for these cubs and all four are doing well. These cubs bring the birth total to 36 animals, with 17 of these surviving at least the first five months of life.

A new $43,000 building was completed early in 1985 adjacent to the east yard to provide extra housing to the Columbus Zoo's growing cheetah collection.

FACILITIES

The west cheetah yard and adjacent building were built in 1971. The yard is approximately one acre surrounded by a 12-foot wire-mesh fence. In 1979 a 3' x 4' concrete block den was built in the center and covered with dirt to form a natural-looking mound. Large rocks were placed in the yard and a few dead trees were cut down and left to lay. These additions to the yard provided spots for the cats to climb on to observe their surroundings and also to defecate on as cheetahs do in the wild.

At the rear of the yard are six small wooden buildings. These "kitty condos" are 40" x 32" x 52" each and heated with two heating lamps boxed in with wire mesh for the safety of the cheetahs. The buildings are tacked to the perimeter fence of the cheetah yard. They have a guillotine door in the front so that a cat can be trapped inside; there is a small door in the back large enough for a keeper to enter for cleaning but small enough for backing a transfer cage up to it.

The cheetah building is accessible to the yard by 13' x 9' wire mesh runs. These runs are also topped by mesh to prevent a cat from climbing out when cornered or agitated.

The runs lead into three individual indoor pens in the cheetah building through guillotine doors. Each measuring 10' x 7', the pens are separated from each other and the keeper aisle by wire mesh. Cats can be transferred from pen to pen through guillotine doors. The concrete floor has heating coils throughout that keep the entire building, especially the floors, warm in cold weather. These cages have a small 20" x 12" hinged door near the floor for the keeper to put the feed pan through. An exhaust fan and air vent have been added to keep fresh air circulating.

The fourth indoor pen, the cubbing den, is part of the original structure but is separated from the rest of the building by a solid wall. The cage is also made of wire mesh, has a hinged door for feeding, a guillotine door for access to an outside run, heated floor, and an exhaust fan. In addition, a dimmer switch can decrease the den lighting for the comfort of the cat or increase it to aid in videotaping.

Videotaping and observing are done through a one-way window installed in the cubbing den end of the building. The window is accessible via a small room attached to the building. As long as this room is kept dark, the cheetah inside the den cannot see observers. Her maternal care is not interrupted and the health of her cubs can be monitored. The videotapes have also proven valuable in education and research.

In 1982 a second cheetah yard was built on the east side of the zoo. This yard is approximately 1/4 mile away from the west yard--far enough that the cats cannot see, smell, or hear one another. The yard is approximately 3/4 of an acre and bordered by a seven-foot wire-mesh fence on three sides. After the smaller, younger cats proved they could climb over this fence, an electric wire was installed along the top. The yard is located in a valley; its front end consists of a concrete block wall above which visitors can stand for an unobstructed view of the cheetahs within.

There are three of the wooden "kitty condos" described previously tacked to

There are three of the wooden "kitty condos" described previously tacked to

Early in 1985 a major building was finished for this second yard. A 50' x 20' pole barn with poured concrete floors, it features twelve 7' x 5 1/2' wire-mesh cages connected by guillotine doors for easy transferring. Guillotine doors also provide access to three 10 1/2' x 7' runs that connect the building to the yard. Two of these indoor pens also have guillotine doors that lead out the back side of the building where a future third yard is planned.

As in the building on the west side, feeding is done through small hinged doors near the floor. Heat is forced electric and a 24-inch two-speed exhaust fan circulates the air. Two 57" x 42" windows have been added to provide the cats inside with natural light. A 14' x 9' kitchen and office area is located in one corner of the building. Here food is prepared, water bowls and feed pans are thoroughly cleaned, and records are kept.

To date, it has not been necessary to tranquilize cheetahs when moving them. Transportation from one yard to the other is done using a 54" x 33" x 40" boxed-in trailer featuring ventilation holes and plexiglas windows for light. The trailer can be hooked up to any vehicle with a hitch, golf cart to truck, and the cat moved easily from one side of the zoo to another.

DIET

The adult male cheetahs are fed three pounds and the females two pounds of Wisconsin brand horsemeat once a day. This diet is supplemented by one Lipo-plus capsule, opened and mixed in, per every pound of meat. The cheetahs are occasionally fasted prior to worming (to insure the cat eats the medicated meat) and before introductions of new cats or reintroductions to force interaction among individuals at feeding time. Sick animals that are not eating their regular diet are given such things as liver, C/D Feline diet, or hamburger to stimulate their appetites.

For diets of hand-raised cubs, see the section on "Hand Rearing."

BREEDING

The observations, conclusions, and practices described here are the result of experiences at the Columbus Zoo. While we believe them to be accurate, they may not prove true in other collections.

Adult female cheetahs are solitary and have contact with one or more males only when in estrus. They need the stimulation of an unfamiliar male to become sexually aroused. Thus, in captivity, breeding is most often achieved following introductions. Since it is most often impractical to bring new males to the zoo, male cheetahs are separated from females for periods of a few weeks to a few months and then reintroduced. Often the length of time the cats are separated is random, but occasionally mating vocalizations uttered by a male or a female signal the keepers to reintroduce the cats.

Competition among males for dominance also seems to be a factor. Females observe these conflicts and seem more receptive to the male that proves dominant. It should be noted that the Columbus Zoo has never had a cheetah seriously injured by doing this and that breeding often occurs after such confrontations. Reintroductions or introductions of more than one male at a time are helpful, but not necessary, for breeding to occur.

When a male is sexually aroused, he utters a mate call. He follows the female closely, sniffing and/or licking her genitals if permitted. He also stoops to sniff the ground where the female has just sat. The dominant male urinates on trees, rocks, and other outcroppings marking his territory.

A receptive female may roll around on her back similar to a housecat in heat. She swishes her tail back and forth in front of the male following her. Breeding occurs when the female suddenly lowers her hindquarters and allows the male to mount her. A nonreceptive female will swat at and fight with a pursuing male.

Gestation periods range from 91 to 93 days. The female gains weight, and her nipples swell a few days before delivery. She licks her nipples clean, removing the surrounding hair. The day of delivery, and sometimes the day before, she will not eat. Birth occurs at any time of day and intervals between the birth of individual cubs ranges from approximately a quarter of an hour to two hours.

HAND REARING

Cubs that are not being cared for by their mother or that develop a health problem are taken to the zoo's nursery. Here they receive round-the-clock care and medical problems can be detected and treated immediately.

Very young cats that cannot maintain their body temperature are kept in incubators set at approximately 80°F. As they get older and do not need the controlled atmosphere of the incubator, a heating pad is substituted. The length of time incubators and heating pads are used depends on the development and health of each individual cat.

Infant cheetahs are fed every three hours day and night. They are stimulated to urinate and/or defecate after every feeding. Individuals respond differently to different formulas, and diets that have been used include Esbilac, KMR, and goat's milk with egg yolk. These formulas are usually diluted as much as 50% with water. Cubs are first weaned by offering them strained baby food liver diluted with formula. As soon as the liver is accepted small amounts of horsemeat are gradually added and the liver and formula are reduced until the cub is readily eating straight horsemeat.

The Columbus Zoo staff is not satisfied that a suitable formula on which to raise these cubs has been found. Different cubs have displayed varying degrees of intolerance (such as loose stools) to these formulas. Most of the zoo's hand-reared cubs have experienced a substantial hair loss, especially in the area of the mane. After consultation with other zoos with similar hair loss in hand-reared cubs, the problem is felt to be dietary.

PolyVisol or Visorbin have been given to supplement the infant cheetahs' diet.

The infants are weighed daily. Temperatures are taken rectally when necessary.

At approximately three months of age, most of these cubs are being fed an adult diet and body functions are regulated. At this time, cubs are removed from the nursery and slowly introduced to the rest of the Columbus Zoo cheetah collection.

ACQUISITION

In the earlier years of cheetah exhibition at the Columbus Zoo, animals were acquired primarily through purchase. The baby cheetah boom of recent years put the zoo in the happy position of being able to pursue the diversification of the cheetah bloodlines without having to purchase new breeding stock. The zoo is actively pursuing a combination of further trades, breeding loans and/or purchases that will increase the bloodlines not only of the Columbus Zoo cheetahs but the captive population as well.

Possible Cause of Infertility in Captive Cheetah

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It is well known, that cheetah populations are diminishing in the wild due to poaching, habitat destruction and possibly to the lack of genetic variation (O'Brien et al, 1985). Captive animals often exhibit reproductive failure as well as shortened life spans. The number of offspring born in North American zoos has decreased annually since 1981 (1984 Cheetah Studbook) and the average adult age of reproductively active females in the captive population is 8.4 years. Most females only reproduce until approximately age 10 so the female breeding population, as a whole, is older and less likely to produce as many cubs.

Observations since the later 1960's, have indicated that captive cheetah were being lost due to liver failure of unknown causes. In 1970 (Dinnes and Henrickson, 1970) and in 1981 (van den Ingh et al, 1981), studies in cheetah demonstrated that the liver failures were due to veno-occlusive disease but the cause remained undetermined. The present study is the first to characterize veno-occlusive disease in captive cheetah as well as determine its association with infertility in sexually mature cheetah.

The livers and/or reproductive organs from more than 100 cheetah were evaluated histologically. The incidence of veno-occlusive disease was 60-65% in adults and most of these animals were known to be infertile before death. This population was compared to a known fertile population in South Africa (De Wildt Cheetah Research and Breeding Centre) that produced 230 cubs in less than 10 years (Bertschinger et al, 1984). No clinical signs of liver failure or hepatic vascular lesions were observed in the DeWildt cheetah. These animals, in contrast to most cheetah in North American zoos, were not fed a commercial diet or horsemeat.

Since the diet was a major difference between these two populations, comparisons of several parameters were made before and after the diet was changed in a group of cheetah at the Cincinnati Zoo. The change was from a commercially prepared feline diet to boneless chicken with vitamin and mineral supplement.

After three months there was improvement in several parameters evaluated (liver function, coagulation time, abnormal mitochondria...). All of these abnormalities, including veno-occlusive disease, have been previously associated with the effects of estrogen used in oral contraceptives in women during 1960-1970's (Alpert, 1976; Heldin, 1975; Perez et al, 1969).

The commercially prepared feline diet was analyzed by gas chromatography-mass spectrometry, allowing the definitive identification of compounds present in the diet. By this method, at least two estrogens derived from plants have been fully identified in large amounts as well as the presence of other estrogens, probably derived from horsemeat. However, even though these estrogens were identified at high levels, it does not necessarily follow that they are biologically active. Therefore, an extract of the diet was subsequently injected into immature female mice as a bioassay. This resulted in a dose related increase in uterine weight within three days which confirmed that the extract was estrogenic and, therefore, could have a similar effect in cheetah. This would also explain the estrogenic lesions observed histologically in the uterus of the female cheetah.

In conclusion, high levels of estrogen were found in commercial exotic feline diet. These exogenous estrogens were determined to be biologically active. The estrogenic effects on the liver and female reproduction observed in the cheetah appear to be reversible after a change in the diet.

Acknowledgements:

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INDUCED ESTRUS IN THE CHEETAH

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Infrequent births, whether because of infertility or failure to become sexually aroused, have characterized the cheetah throughout its captive history. According to Marker (1983), only 10-15% of wild caught cheetahs have bred successfully since 1970. Marker's conclusion that cheetah fecundity in captivity "has been poor at best" seems to be borne out even in those programs termed successful. For example, in its first six years of operation the San Diego Wild Animal Park's program attracted considerable attention as a result of the birth of seven litters. But number of litters by itself is a crude measure, for it provides no basis for measuring actual against potential results. Calculations based on the years in which female cheetahs in the San Diego facility were potentially reproductive reveal that births occurred at a rate of one litter each 3.7 years of each female's reproductive life. Although similar data for other colonies are not yet available, the premise that captive reproduction for this species is disappointingly infrequent seems valid.

The causes of reproductive failure in the cheetah are poorly described and ill-defined; however, most observers are familiar with the example of individuals in apparently good breeding condition who are sexually unresponsive. When tested, the response of these individuals to exogenous gonadotropin therapy usually indicates gonadal competence, and implies a defect at the level of the pituitary or central nervous system. These indicators, along with the relatively poor success in inducing fertile ovulations with exogenous gonadotropins, have stimulated the development of new therapies for enhancing reproduction in the cheetah. Our report describes one new approach, still experimental and preliminary, which entails pituitary stimulation by means of GnRH "pumps" implanted subcutaneously. Gonadotropin-releasing hormone (GnRH) is a decapeptide which is produced by the hypothalamus and which causes the release of luteinizing hormone (LH) and follicle stimulating hormone (FSH) from the pituitary. These hormones in turn stimulate the gonads, resulting in follicular growth and ovulation. Recent studies with humans have shown that exogenous GnRH administered as repetitive doses or pulses over a period of 2-3 weeks is effective in stimulating ovulation in women who suffer hypothalamic deficiencies. Small, peanut-sized osmotic pumps, which can be implanted under the skin of exotic animals, deliver pulsatile GnRH for periods up to 10 days without the need for repetitive capture and restraint. Females treated in this manner are thus available for mating tests with virile males of proven fertility. While this basic approach has been employed successfully for some time with humans and domesticated animals, its application to exotic or nondomesticated species was pioneered in our endocrine laboratory in San Diego.

We describe here three cases in which GnRH pumps were tested with cheetah females. In all cases blood samples were drawn on the day of implantation and analyzed for progesterone. Values of <1 ng/ml of serum indicate that the treatment (pump) did not coincide with a pre-existing corpus luteum.

The first case was a nine-year old female brought into our hospital for short-term treatment of a nasal infection. Although regularly exposed to breeding males, this female had failed to exhibit estrus throughout the seven years of her adult life. Our first maneuver had limited objectives: to determine if an implant would be worn comfortably, to determine if the pump would deliver GnRH in the expected manner, and to determine whether blood samples taken at the time of implant and removal, (11 days later), would produce evidence of a physiological response. A rise in progesterone from <1 to 14 ng/ml by day 11 (Fig. 1, C) in this female indicated that further testing was warranted.

The second test was with a female who had spontaneously come into estrus twice in the first half of 1982, resulting in two litters, both of which were abandoned. In our facility females live together in a 4-acre enclosure. Males are maintained separately, in adjoining 50x50' pens. An open pen, connected by a runway to the female enclosure allows females to enter the males' area at will. All mating tests are conducted in the neutral pen. Upon release, males typically spend the first few minutes sniffing the area, showing the flehmen response, and urine marking. Social encounters on most test days are aggressive in nature, leading to early termination of pairings. On the two occassions here termed spontaneous estrus, olfactory exploration led to penile erection and stutter-bark vocalizing by the male. Social contact was initially aggressive, with chasing and paw swipes, but the female then made overtures in the form of following and swiping at the male, and by assumption of the lordosis posture. Copulation in the first estrus occurred on two successive days, 43 and 3 minutes after introduction of the male.

Although repeatedly tested with males over the 18 months following birth and abandonment of her last litter, all pairings of this female were characterized by either indifference or hostility on the part of one or both sexes. In early 1984 this female, now 8 years of age, was implanted with a GnRH pump. She was tested with a male 3, 5, and 7 days before the scheduled procedure, and all tests had to be terminated after a few minutes as a result of male aggressiveness. Testing was resumed 4 days after implantation on a daily basis for the next 10 days, and on alternate days thereafter. On days 62 and 63, this female underwent estrus indistinguishable in detail from the spontaneous episodes of 24 months earlier. The major difference was that copulation occurred much sooner after introduction of the male (3 and <1 minute) than in the spontaneous estrus. Blood values for samples taken on the day of pump implantation and removal (9 days later) showed elevation of progesterone from <1 to 25 ng/ml (Fig. 1, A). A third sample taken 90 days after implantation indicated a value of 49 ng/ml. This female delivered a litter of two cubs 95 days after mating (157 days following implantation).

The third case is of a female received in our facility on breeding loan in November, 1983. She was 10 years of age and, according to her owner, had never shown any interest in mating. Approximately 10 weeks after arrival, this female underwent an episode of spontaneous estrus not unlike that described for female A above. Despite many attempts at copulation on two successive days, this result was not achieved due to improper orientation of one or both individuals. We are unable to explain estrus at this time, though there are suggestions in the literature that a change in circumstances, i.e., a new location or exposure to a strange male, will sometimes lead to mating.

Though tested periodically over the next eight months, this female remained sexually unresponsive. She was then implanted with a GnRH pump, and similar to the previous case, came onto heat 55 days later. Estrus was in all details extremely similar to the spontaneous event eight months earlier, including failure to orient properly for copulation. Because of her tractable nature, it was possible to repeatedly net this female in order to draw blood samples. As in the previous two cases, progesterone values rose from baseline within a few days of the initiation of the procedure. Altogether, eight samples were drawn, with the sample taken 14 days after implantation showing a peak value of 17 ng/ml, but declining thereafter to <1 ng/ml at the time of estrus, then rising again to 18 ng/ml some three weeks after mating (Fig. 1, B). These results are strongly suggestive of two ovulations, followed in each case by a functional corpus luteum. Conception in this individual was presumably precluded only by the behavioral deficiencies of the pair at the time of ovulation.

It is possible that the results in each of these cases are coincidental, but the progesterone values obtained at the time of implantation and the similar time course of events from implantation to the occurrence of estrus in two of the females makes that prospect unlikely. Clearly, the promise of this approach to stimulation of ovulation and estrus in the cheetah can be realized only through further testing. The difficulties encountered in obtaining information on feline physiology, constrained to some extent by economics and by our reluctance to use frequent restraint, means that progress will be slow. Much remains to be learned about the timing and frequency of GnRH administration and its mode of action in the cheetah before concluding that we have an approach which will significantly impact on future reproduction.

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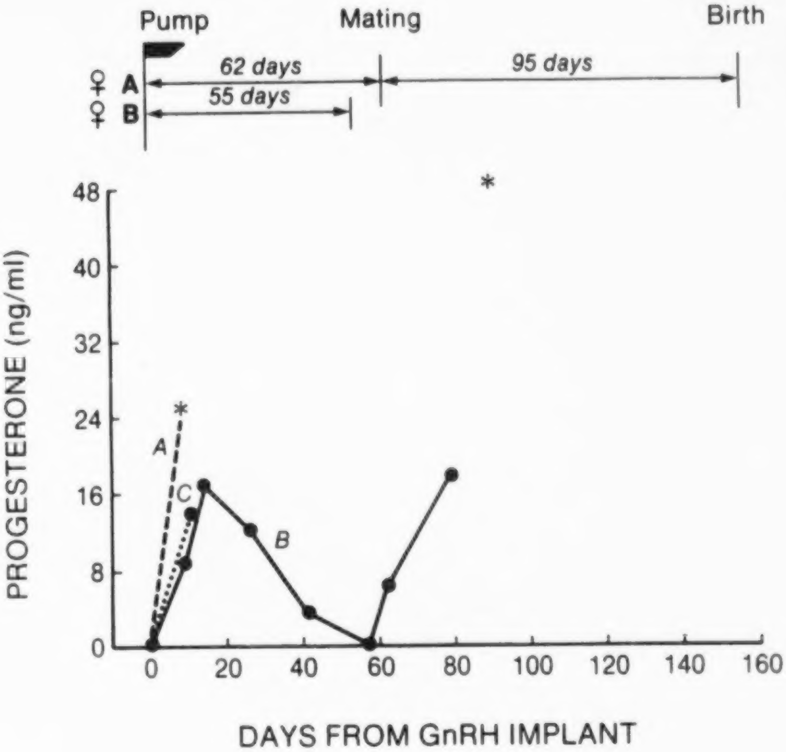
FIGURE LEGEND

Fig. 1 - Time course of progesterone excretion and behavioral events in three female cheetahs implanted with GnRH pumps.



NON-INVASIVE SEMEN COLLECTION IN THE CHEETAH (*Acinonyx jubatus*)

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Introduction

It has become increasingly difficult to import the endangered cheetah from Africa. Therefore, captive breeding must be enhanced to enlarge the population now dwindling in zoological collections. The alarming fact is that more than 85% of the cheetahs brought into captivity in the last 15 years have failed to reproduce. Efforts to preserve this unique species must be carefully designed to provide an understanding of the basic physiological mechanisms of reproduction. Only then will there be consistent success with artificial captive propagation or attempts to bring genetic material from wild populations to captive groups.

Several investigators have undertaken research that will elucidate the details of ovulation and semen production in the cheetah. Wildt *et al*. (1981) achieved follicular development and ovulation in cheetahs treated with gonadotropins. Lasley and Wing (1983) explored the effectiveness of gonadotropin-releasing hormone pulses in stimulating ovarian function in cheetahs. Wildt and his coworkers (1983) reported semen parameters of 22 electroejaculated cheetahs in South Africa. Studies of this kind are continuing to accumulate scientific knowledge which will aid in captive breeding efforts.

Methods

At the San Diego Wild Animal Park, a three year-old male cheetah rejected by his mother was hand-raised and trained to participate in an educational program. The animal's sexual interest in certain inanimate objects alerted his keepers to his potential as a semen donor.

The cheetah was readily trained with food rewards to service an artificial vagina. The device, similar to commerical units for domestic livestock, is constructed of a short length of rigid hose. A latex liner is filled with warm water and folded back over each end of the hose. Another, inner liner is connected to a collection bottle. The entire device is warmed to body temperature. Semen is collected with the hand-held device 2-3 times monthly without stress to the cheetah or interruption of his normal routine.

Results and Discussion

Twelve semen samples collected over a six-month period have been analyed. Average semen parameters are depicted in Table I. Unextended semen was examined immediately after collection for motility and speed of forward progression. The latter is a score of 0-5 with 0 representing no sperm movement, 5 depicting rapid forward progression. Volume was measured before an aliquot was removed for concentration determination. Slides were fixed in 1:1 methanol:ether for later morphological evaluation of sperm.

The average volume of semen collected from this animal was smaller (.50 ml) than that of electroejaculated cheetahs (2.1 ml; Wildt et al., 1983). This difference could be simply individual variation. However, it is more likely due to the interruption of the collection procedure prior to the expression of aggressive behavior usually observed between naturally mating cheetahs after copulation. Although the sperm concentration per ml is higher in the hand-raised cheetah, the larger volume of the electroejaculated animals yields a greater total number of sperm per sample. Motility and speed of progression scores in the present study are equivalent to those reported for cheetahs in Africa.

The total percent of morphological abnormalities, 65.3, is quite high compared to domestic cats (approx. 30%; Wildt et al., 1983) and most other mammals (40% for fertile males; Chenoweth and Ball, 1980). It is slightly less, though, than other figures reported for cheetahs (Wildt et al., 1983; Brand, 1980). The etiology of this unusual condition of increased abnormalities in cheetah sperm is as yet unknown but may be associated with extreme monomorphism at a variety of usually polymorphic loci, including the major histocompatibility complex (O'Brien et al., 1983). Monomorphism to that degree is seen in highly inbred groups of animals often experiencing reproductive difficulty.

Table II depicts the types of sperm abnormalities observed. Authors differ slightly with regard to classification, but primary abnormalities are recognized as errors in spermatozoon assembly. Secondary abnormalities occur during sperm passage or storage and are considered less important in predicting fertility.

Summary

The non-invasive technique described allows frequent semen collection without stress to the animal. This technique, or modifications of it, will allow the utilization of genetic material from males incapable of natural breeding, or geographically distant from females.

Repeated collections from this cheetah will help establish normal semen parameters of this endangered species. Multiple samples from the same individual may demonstrate seasonal changes in spermatogenesis and aid in the development of semen cryopreservation methods for cheetahs, perhaps lending insight into basic sperm physiology which can benefit other exotic species.

TABLE I: SEMEN VALUES OF 12 EJACULATES

Parameter	x ± S.E.	Range
Volume (ml)	0.50 ± 0.24	0.20 - 0.95
Concentration (x10^6/ml)	22.50 ± 12.80	6.30 - 50.0
Motility (%)	58.30 ± 25.60	10 - 90
Speed of Progression (0-5, 5 highest)	3.70 ± 1.25	2 - 5
pH	8.70 ± 0.15	8.50 - 8.9
Morphological Abnormalities	65.30 ± 13.60	49 - 91

TABLE II: SPERM MORPHOLOGY

Trait	x ± S.E.	Range
% ABNORMALITIES		
Primary		
Abnormal Midpiece	2.4 ± 1.7	0 - 7
Abnormal Head Attachment	1.9 ± 2.1	0 - 8
Abnormal Acrosome	5.9 ± 3.1	0 - 17
Biflagellate	0.1 ± 0.0	0 - 1
Bicephalic	0.1 ± 0.0	0 - 1
Macrocephalic	0.3 ± 0.4	0 - 1
Microcephalic	2.1 ± 1.5	0 - 6
Pyriform Head	1.3 ± 1.4	0 - 6
Abaxial Flagellar Attachment	0.6 ± 0.9	0 - 3
Truncated	1.1 ± 0.8	0 - 3
Secondary		
Detached Head	12.4 ± 10.7	0 - 28
Coiled Tail	7.3 ± 6.0	1 - 24
Protoplasmic Droplet (immature)	2.1 ± 1.4	0 - 5
Bent Flagella or Neck	28.1 ± 8.9	17 - 47
TOTAL (Abnormalities/Ejaculate)	65.3 ± 13.6	49 - 91
DIMENSIONS (μ)		
Head Length	4.1 ± 0.36	4 - 5
Midpiece Length	4.7 ± 0.69	4 - 8
Tail Length	44.1 ± 3.20	41 - 50
TOTAL LENGTH	52.9 ± 3.30	50 - 60

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REPRODUCTIVE, GENETIC AND CLINICAL STUDIES OF FREE-RANGING AFRICAN WILDLIFE

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The purpose of this presentation was to demonstrate with slides and video tape the feasibility of collecting biological materials from free-ranging African wildlife. Studies by the authors concentrate on developing and improving methods of chemical immobilization of wild species, in particular the elephant, lion, cheetah and giraffe. After anesthesia induction, biological materials are collected including blood for genetic and hormonal analyses and semen for evaluation of ejaculate characteristics and development of techniques for cryopreserving spermatozoa. The implications of these data on the management and genetic and reproductive status of these species in the wild and in captivity was discussed.

WALKING THE TV TIGHTROPE by Joan Embery

How many of you here today have watched a superbowl game? This year advertisers who purchase thirty-second commercials will pay $550,000 for the opportunity. That amount is more than the total operating budget of one half of the zoos in the United States. The local evening news at 5-7 p.m. costs from $1,000 to $2,000. Advertising costs are based on the time slot, the ratings or popularity of a show and the size of the market. Therefore, a top rated network show such as ABC's "Good Morning America" charges $20,000 for a thirty-second commercial while NBC's "The Tonight Show" costs $40,000.

Television is the fastest growing advertising medium and number one in national advertising dollars. It has flexibility and is considered by many to be the best medium because of its visual dimension, and the capacity to reach the largest number of people. One appearance on "The Tonight Show" can reach up to thirty million people. Mailing a post card to that many people would cost over four million dollars. Few zoos are capable of allocating major expenditures for television advertising and in addition to airing costs are the production costs for commercials, which are significant.

There is an alternative opportunity to participate in the market by becoming part of the programming supported by advertisers. In this format it is possible to expand the air time to a segment lasting from one to fifteen minutes, or longer. An added benefit is the impact of involving well known television personalities that the audience relates to.

Among the types of shows accessible for our use are news programs, talk shows, magazine format shows, nature programs, educational shows, children's shows, public broadcasting, specials, telethons and public service announcements. All of these shows are in need of programming ideas on a regular basis...they may not be aware of what you have to offer. Formats vary as do their programming needs according to their target market. Often participation on one show leads to other opportunities such as the "Animal Express", a 130 half-hour series all on animals in zoos, parks, and aquariums. Distributed worldwide by Twentieth Century Fox, it will go on air this fall.

The booking for shows is handled by talent coordinators or, in the case of smaller productions, the producer. The greater the size of the audience and the advertising value, the more competitive it becomes to get a booking. Many more are turned away than appear. On large budget shows an audition or pre-interview may be required for first time guests. Entertainment is often the key element. You should try to achieve your goal of informing, educating or selling an idea without losing the entertainment value. Booking time varies from a last minute call to weeks in advance. Often air dates are scheduled weeks after tapings so early booking is important for dated information.

Availability can be important in scheduling shows since you often must work around their schedules and preferences. On occassion shows will call with a specific idea in mind, and if it is not possible or reasonable to accommodate them, try to give them ideas of what could be done. It may lead to future opportunities. Some shows are hard to please but remember, competition is stiff for free air time.

Talent coordinators may have no idea what a "slow loris" is, or for that matter what nocturnal, arboreal, or primate means. The most commonly asked questions is "what does it do?". Often talent coordinators think of trained animals they have seen in commercials or movies. Try to convince them of the value of an animal doing what is natural. Animals can be augmented with video of what may not be shown in the studio or related visual materials.

Animals are a great aid in capturing the attention of the audience. It is always challenging to find animals that can be safely transported and handled on a television set. We are lucky in San Diego to have a large collection to choose from -- though a small percentage are candidates for television work. Most often we draw from our trained animal shows, education animals, young animals being hand raised in the nursery, or those which can be physically controlled. Occasionally we build special viewing cages or stands to display them. It can be difficult to predict in advance how an animal will respond once removed from its familiar environment. Seemingly calm, tractible animals may become untrustworthy in unfamiliar surroundings.

The first concern is how it can be safely transported... will it accept the confines of a shipping crate or trailer... can the temperature be sufficiently controlled...are permits required (health, Animal Regulation, fire department, etc.). Proximity to the market and costs of shipping determine the feasibility. Sometimes shows are willing to cover transportation costs. You should allow plenty of time for any problems that may occur enroute -- with expensive production costs most shows will not wait for their guests, even if they are taped.

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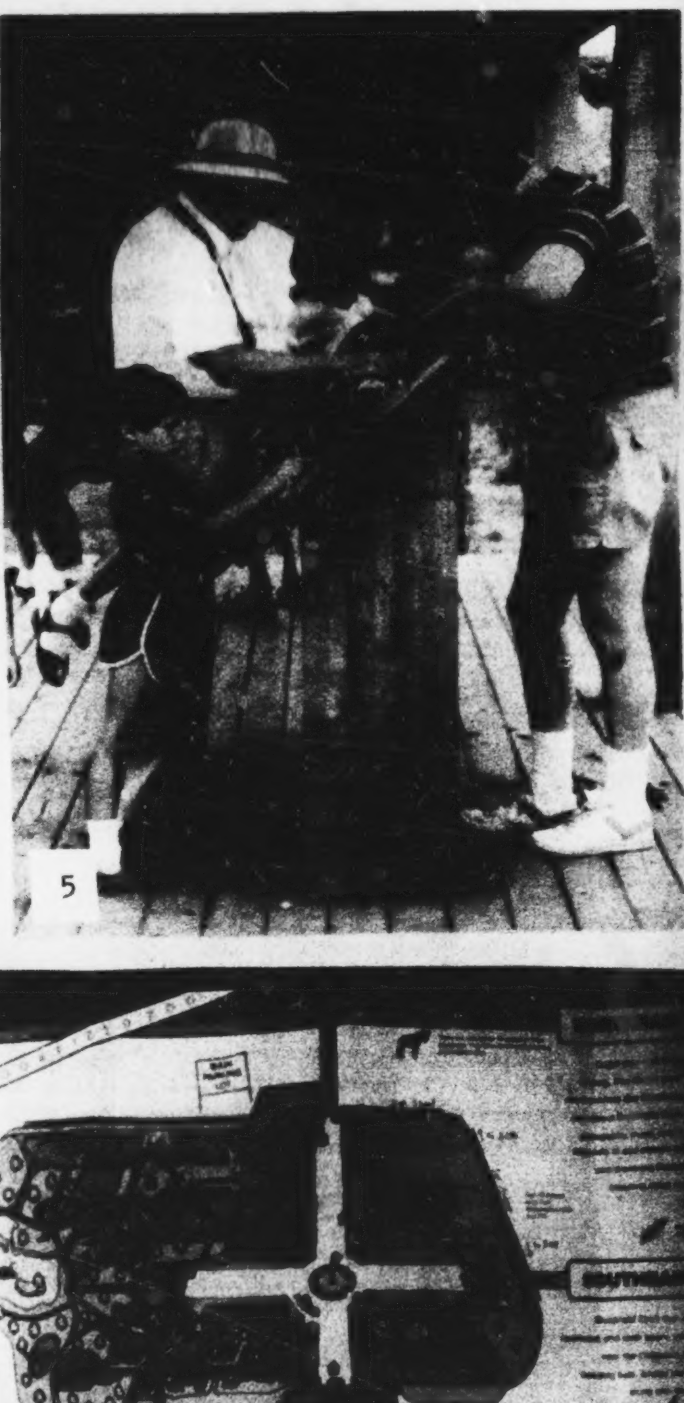

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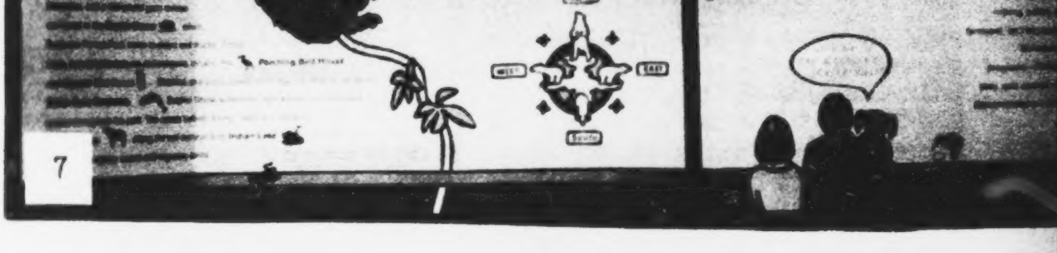

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At the studio there are many considerations...such as access, footing, cameras, lights, sound equipment, music, audience, temperature, and unions. For the most part, stage crews are accustomed to working with actors and trained television professionals -- not with animals. It's your responsibility to determine your needs and relate them to the appropriate crew members. The best access to the stage should be established before you enter the studio. Footing is an extremely important consideration particularly with hooved animals. Often the floor surfaces are highly polished and extremely slick. Carpeting or plastic runners may need to be requested in advance for the safety of animals and handlers.

Usually the stage director will want to establish camera angles and lighting before the appearance. It is not unusual to be given unrealistic directions as to how and where to enter the stage. You may be asked to hit a given mark on stage. It is at this time that you should voice any concerns you have. Many shows have a band and a live audience that is encouraged to applaud. This sound can be alarming to many animals and if you suspect an adverse reaction ask them to soften the music and omit the applause. Most studios use powerful lights that generate a great deal of heat on stage. It csn get very warm and to compensate the studios are heavily air conditioned. This is a consideration for temperature sensitive animals. Often dressing rooms have a more consistent temperature.

Unions play an important role in most studios, controlling who can work in each specific area. An electrician cannot handle props and a propman cannot handle electrical problems. You may not even be allowed to handle your own equipment if it falls into a union category. On one occassion we had taken a baby southern white rhino to a show that was to be contained in a pipe playpen. When the crew saw us moving the pen into the studio we were told not to handle it -- it was their job. But when they couldn't figure out how to assemble it we were called back to quickly put it together before air time.

The performer or spokesperson is also subject to union restrictions. Regular appearances on television will require membership in the American Federation of Television and Radio Artists (AFTRA). You may be asked for a membership card showing currently paid dues. Any payments to you will first be cleared through the union which monitors appearances. One zoo employee was sent a statement crediting payment from his appearance toward initiation dues with a request that the balance be paid before he could appear again. The demands on the spokesperson and animals vary according to the show's format...some are easier to please than others...budgets and audiences vary.

Educational programs take a more serious approach while shows like "The Tonight Show" are entertainment oriented. Although entertainment shows may not afford the same latitude in program subject matter, they have the largest audiences. Those who tune in to nature programs are already supporters of wildlife; but on the entertainment shows we have an opportunity to reach a different audience that may be unaware of our programs. News programs may be looking for something timely while children's shows want to appeal to a younger audience. Although shows may be aware of your desire to promote something, most expect it to be tastefully done, and secondary to their programming needs. If you just want a commercial they expect you to pay for it.

Time is money in the television business. There isn't time to wait on an animal once taping begins. If you expect possible problems with an animal, try to place it before a commercial break so the show can cut to the commercial if necessary. Bring a backup animal that is reliable and can be substituted if necessary. Don't try to force the issue if you expect problems. It's better to be safe than sorry. A bad show is worse than a no show.

Time flys once you are on the air so it is important to have a clear picture in your mind of the most important points. Since television is a visual medium it's important to relate to what is happening. Although animals are a good attention getter, they can also steal the show just when you are making an important statement. Hosts can also interrupt your train of thought but remember, it is "their" show. The spokesperson must also contend with the wishes of the zoo staff which often suggest how they would like the taping to be handled. It is extremely difficult to please everyone involved. Time limitations restrict your ability to say all that you would like, but be prepared should you get the opportunity. Occasionally animals will be cut because of time limitations. It is even possible that your entire appearance could be cut and have to be rescheduled, although unlikely. Important breaking news or unexpected opportunities for top name guests can change show formats at the last minute.

Two to fifteen minutes on air may involve days of planning and up to twenty hours of work on the day of an appearance, but we can reach millions of people who may well determine the future of our wildlife. Hopefully, these appearances will benefit all of us in zoos, parks and aquariums who have a common goal in wildlife preservation.

# #

The Zoo Publicist - Between a Rock and a Hard Place

Janet Ross
Miami Metrozoo

The purpose of this paper is to maximize publicity opportunities available to zoos and aquariums. We are in a unique position -- even with no public relations personnel, or without sending out one press release, the media call upon their area zoo or aquarium. The public has always been interested in animals, even though their perceptions may be more emotional than realistic. But proper media exposure can help educate the public -- even those that don't come to our parks to get our educational message. And the bottom line, in justifying your PR person's salary, is keeping the zoo message in the public mind, thereby increasing attendance and/or financial support. As you've heard more and more at these conferences through the years, we have to compete for that leisure dollar more than ever before, due to increasing competition and shrinking government subsidies.

Before I endanger losing the job I love so much, let me emphasize that my perceptions for this paper are based on talking to PR staffers at zoos and aquariums across the country. In fact, much of the inspiration for this paper came from talking to my cohorts at last year's conference, usually in the bars at the Omni Hotel. I might add, at this point, that my colleagues at profit-making institutions, such as Sea World and Busch Gardens, don't seem to have the same frustrations, or at least not to the same degree, indicating that what I'm about to say does, indeed, result in financial benefit for our institutions, which is recognized by those institutions whose management is geared to maximum profit with minimum expense. They do so without necessarily sacrificing their images as scientific institutions with credible goals, too.

The biggest impediment to the zoo publicist's ability to gain positive exposure for his/her institution is lack of information.

Granted, the zoo publicist isn't the only one on the staff not informed at times, and the problem is not exclusive to zoos. But the problem exists, and it costs the zoo money. And it does seem to be a genetic deficiency on the part of animal staffers to forget PR staffers.

The publicist should know everything. And this should be made clear from the zoo director on down. If you can't trust your PR person not to run to the phone without clearance every time you tell them something, you've hired the wrong person! Many times, animal people simply forget to tell publicists important stories, or they keep secret stories they feel are potential trouble, or if they do think of the PR person, they make the decision that the story isn't newsworthy. But your PR person is the one with the most expertise in this area, and should be included in the decision-making process of whether a story should be publicized or not. It's a sense that's developed, despite the fact that almost everyone, in every business, thinks they know how to do PR. A very common baby animal, seemingly insignificant to your curator, might make a priceless photograph that goes over the wire worldwide. On the other hand, what some zoo staffers think is the most significant story on earth may not have media possibilities, such as flashlight fish that can't be photographed. Special interest groups within a zoo are particularly prone to thinking their special event or fund-raiser is the most important thing on the planet when there may be 20 just like them occurring throughout the city at the same time. An understanding of lead time for certain media outlets is also important.

But the exchange of information is crucial. Including the PR staffer in news of all activities is important. Even maintenance should keep the PR staffer informed. It's embarrassing and damaging to your credibility to be taking a news crew or a visiting travel writer around, raving about your gorilla collection, only to come upon the exhibit to find the animals aren't on display for the day due to maintenance work. But for the animal staff, if they fail to tell the publicist of some event or planned event, it should be considered as much a failing as if they forget to lock an exhibit door. All animal staffers, particularly the keepers who tend to be very proud of activities within their areas, should feel free to stop by the publicist's office with news of the day, whether it seems important or not.

This does not imply that considerations of animal safety or curatorial input won't be considered either. It's just to say that the publicist must be a part of the decision-making process. Even if an accident occurs, which rarely makes for good copy, your publicist should be informed. There's nothing more embarrassing or damaging to your professional reputation than when the media call knowing something going on at your zoo that you don't know about. Inform PR so they can get the facts together and be prepared. Yet, don't expect your public relations staff to cover up for your mistakes. If something needs improvement, fix it! If unsafe conditions exist, correct them before an accident happens. As someone commented at the Vancouver conference, the media always eventually find out the truth. They're professionals, and that's their job. And once a reporter discovers you've lied to them, no matter how minor the issue or how good your intent, you've lost the media's credibility forever. This will encourage the media to think there's a lot more being covered up, and they'll dig for dirt even where none exists, or they'll put the most negative slant on every story.

Sometimes animal staffers refuse to allow media coverage of certain activities "in case something goes wrong." If a stranger's presence will be a danger, or if there simply isn't room, then banning the media from an examination or treatment is proper. But the PR staffer can prep the media for the risks involved in surgical procedures or births, even enhancing the scientific aspects of your organization. And news crews can take turns, too. And in many cases, it makes sense to wait a couple of days if a recently born animal isn't stable, before an announcement to the media is made. But when it's an Indian rhino or an albino gorilla, the media have to know right away, or it's old news and again, they'll wonder what else you're keeping secret. Your publicist can prepare the media and the public for the possibility of a baby not making it, with explanations of the risks involved. If you're honest with the media, they really aren't out to screw you! On the publicist's part, accuracy in all aspects of a press release is essential -- journalistic style should be followed, so the editors have complete trust in the accuracy of every part of the story. Smaller community newspapers will even run everything you send them, verbatim, once you've established this trust.

Regardless of the situation, the exchange of information with your publicist has to be free and open. A former colleague of mine, no longer in the business, was once told by the zoo director to "sleuth it out" when trying to get information on something that had occurred. I realize the lapse of information isn't always intentional. But again, it should be a mandatory part of the job of the animal staffer to keep the publicist informed. It's nice if your PR staffer has the time to ask everyone, every day, if anything has happened, or to tour the entire zoo every day, but it's inefficient and more than likely impossible for someone who usually has several duties anyway.

The publicist has a responsibility to strike the right balance in positioning the zoo in the media's and the public's mind. You can't expect the media and public to take you seriously if you promote anthropomorphic, cutesie images of the zoo's animals with hokey promotions and birthday parties. And tie-ins with AAZPA, where appropriate, can go a long way toward enhancing your credibility. This area, though, is where the media have some homework to do, as well. As you all know, a reporter's first question about an animal will always be, "What's its name?" If the animal has a name, tell him so. Again, just be honest. The modern zoo and aquarium, out of financial necessity, strikes a balance between a serious, scientific institution and a fun, entertaining place, and should be presented as such. It's the publicist's job to educate the media and the public that just because an animal is in a zoo does not mean it is trained or tame, or can be posed. The media would benefit from doing a little homework. If you can encourage your local newspaper to send out a regular reporter on the zoo beat, so you don't have to keep explaining the basics, it helps. But you can't demand it. The animal staff has to exhibit some patience when members of the media don't happen to be as informed on animal issues as they are. If they were, they'd be working at a zoo, if it paid more. But animal personnel have to keep in mind that the media reflect public interest. Patient answers can help educate the media and the public at the same time. The media also must learn, though, that the zoo can't always fulfill sudden demands. For the daily newspaper stories and TV coverage of breaking events, advance notice is impossible. But in cases of lengthy features or commercial shoots, poor planning is no excuse for sudden demands. The media have to learn they can get more cooperation with more notice.

So -- given that your publicist is going to know everything and, time allowing, will make the most of what goes on at your institution.....it also helps to allow your publicist to develop certain personnel for media appearances and interviews, and to develop some animals for publicity purposes, as well. Just as the PR staffer has expertise in what is newsworthy, they also should have input on who makes media appearances. The most knowledgeable subject for a TV appearance may not be the most suitable for TV shows. Consider PR input here, too. And no PR staffer wants to endanger an animal's reproductive potential or health by handling or manipulation for publicity purposes. But if putting a bale of alfalfa in a certain spot will get an animal in camera view, what's the harm in that? Or if your institution has on hand a certain number of handleable animals, such as snakes, or other animals used in docent outreach programs, their value for media appearances can not be overstated. And you're not going to confuse the public on the issue of whether animals at a zoo are tame or not. You can get your educational message across.

And if you're a northern zoo presented with a pet groundhog that the owner doesn't want anymore, take it! Your local media will literally be eternally grateful and help you and love you forever if you can give them a shot of a groundhog on Groundhog's Day. You don't have to profess to believe in the groundhog's ability to predict the weather -- I always referred to the theory as a colorful legend when sending out the press release letting the media know we had an actual groundhog available for them to shoot. Why should some groundhog from Philadelphia get your local publicity? And believe me, the media will be out in force.

The funniest things used to happen on Groundhog's Day in Cincinnati during the years I was there. After I stressed the importance of having a groundhog on hand, a staff member in the education department accepted one and took it home for its winter hibernation. I talked to her about needing it in at the zoo for Groundhog's Day, so the day before she went out into her backyard to wake up this groundhog that she thought was hibernating. But it wouldn't wake up.....ever again! The funniest part was that she came to me in my office that morning, practically in tears she was so upset. And she said, "I brought him in anyway, in case you can do anything with him. He's in the back seat of my car." The poor woman was so upset, and wrongly feeling responsible, but I had to laugh. What was I going to do? Take the animal while still in a malleable stage of rigor mortis and pose him as if looking for his shadow?

Then there were the Unitarians. They felt left out all the time because there are no religious holidays when you're a Unitarian. So they picked Groundhog's Day as their arbitrary, non-religious holiday, just so they could have something to celebrate. We used to take the groundhog out to their picnic sun-up breakfast for a mock groundhog hunt. I mean, the possibilities are endless!

The media are an irreverent, cynical lot anyway, which is my background. Zoo persons need to learn not to be so sensitive when it's only meant in jest. An example of the cynicism of the press is demonstrated by the comment of a newspaper friend of mine, made last Easter. He said, "OK, now, let me get this straight.....if Jesus Christ comes out of his cave, and sees his shadow, there's six more weeks of winter, right?"

Besides Groundhog's Day, which can't be counted among the world's most significant occasions, holidays are an ideal time for media exposure. The media is desperate for stories to fill their pages or their broadcasts, since there is no legislation being passed, no press conferences being held, no business being conducted. Developing promotions around holidays, tastefully done, of course, can provide you with a lot of exposure. If you can goose your animals into giving birth on holidays, even better! I'll never forget my first Christmas at the Cincinnati Zoo, back in 1976, when a gorilla gave birth on Christmas morning. Because not a whole lot of other newsworthy things were going on, the result was a huge photo of the baby gorilla on page one of the newspaper the next day. If you can believe it, the newspaper got a lot of angry letters from the religious contingent, who were outraged that a photo of a baby ape was on the front page instead of a picture of the baby Jesus. Now I'm sure if the newspaper had been able to come up with a photo of the baby Jesus, they would have run it. And I'm also sure, if Ed Maruska could have arranged it, he would have!

The point of all this is that every zoo and aquarium can do so much in the way of free exposure, which is the envy of every other business or non-profit organization in town. If it's handled professionally, so the media know they can trust your news judgment, your accuracy and your assistance, it's money in the coffers. Every missed publicity opportunity ultimately means less money for our institutions, perhaps another species gone extinct. The goals of the dedicated zoo publicist are the same as those of the animal staffer -- he or she just employs different talents toward the same end. We can learn from each other, if only we share with each other.

WE ARE HERE: THREE YEARS OF WAYFINDING STUDIES AT BROOKFIELD ZOO

Beverly Serrell, Graphics Consultant, Chicago, IL; Hannah Jennings, Manager, Design, Brookfield Zoo, Chicago, IL.

Introduction

Wayfinding devices—such as "You Are Here" maps and directional signs—are integral parts of most zoo signage. The use of color coding; the so-called international symbol systems, and arrows with names are common, yet there is little data to confirm that wayfinding graphics are as good as they could be.

Brookfield Zoo, a 200 acre park laid out in the grand plan of a central formal garden with parallel pathways combined with winding walks on the east and west perimeters, presents a formidable challenge for new as well as repeat visitors. The earliest wayfinding provisions were maps of the park included in the official guidebook and colorful, three dimensional signs made by a WPA project in the 1930s, which pointed in the direction of some of the more popular exhibits and services (Figure 1).

From the years 1973 to 1984, large mapboards (Figure 2) were provided in thirteen locations of the zoo. These maps were characterized by the use of symbols rather than words, in an abstract interpretation without any perspective. The symbol for "you are here" was an arrow, applied as a decal to each map at the respective correct point. This decal was regularly removed or moved by visitors, decreasing the overall effectiveness of the map. The individual, dimensional symbols were also removed frequently, perhaps as souveniers.

In 1983, the then-current mapboards were in a state of dis-repair. The question arose of whether those maps should be replaced as is or changed. Some staff members felt that the maps were good, and that the visitors who had trouble with them were people who couldn't read maps anyway, so why should we change them. Others doubted their effectiveness and felt that the zoo could do a better job. In addition, directional signs (Figure 3)—which were installed in only one portion of the zoo—were confusing to some people.

Visits to other zoos made us realize that other, interesting and better possibilities existed.

Starting in 1983, continuing to the present, and planned for the future are a series of wayfinding evaluation studies to get at the question of "How well does it work?" Over the past three years, visitors have been tracked, observed, timed, interviewed, and tested to see what methods they use to find their way in the zoo, and how effective are the different devices we provide.

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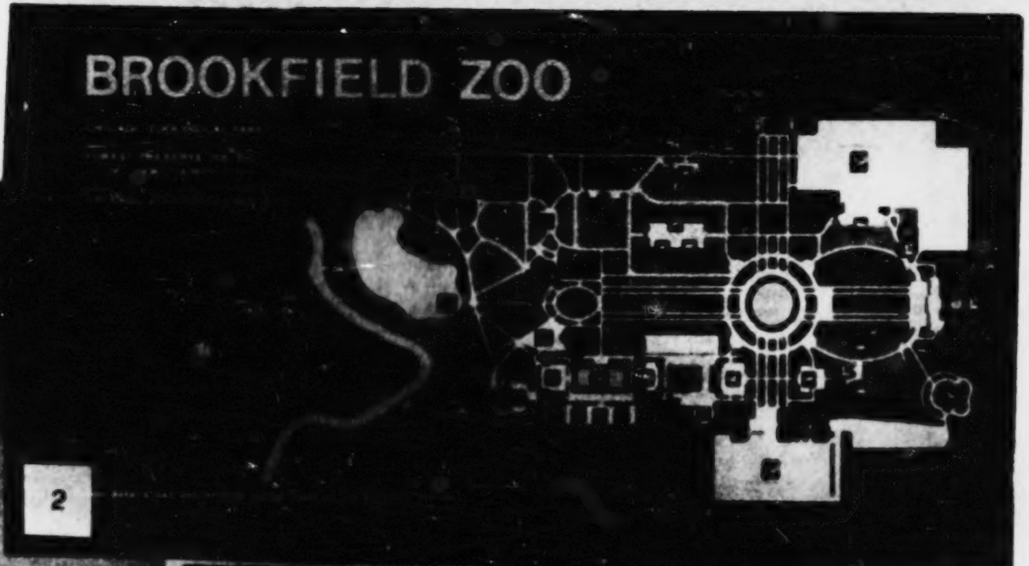
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The main purpose of the evaluation studies was to gather data to help make decisions about the design, content, and number of wayfinding devices. How many were needed? What worked best? Who used them? What problems were visitors experiencing? The evaluations were conducted mostly by in-house staff and volunteers, with the help of a consultant to refine the data-gathering forms and assist with data processing. The various study samples ranged from 10 to over 100, and although they were gathered without tight controls over random sampling techniques, they yielded information helpful for making decisions about how to proceed with the design of wayfinding devices. Evaluation was used to check intuitive hunches, and to eliminate arguments based on conflicting intuitive judgements. Again and again, the question was put to the visitors: Is it working?

1983 Studies

In 1983, we began by critically examining what visitors had been using for years: the symbolic maps and directional signs. What, in fact, did those symbols communicate?

By interviewing visitors, showing them one symbol at a time and asking them what they thought it stood for, we found that out of 25 different animal symbols, only nine were completely unambiguous: camel, penguin, giraffe, seals, dolphin/porpoise, buffalo/bison, elephant, lion, and zebra. There was confusion over symbols for many of the horned ungulates, cats, exotic birds, and other unfamiliar animals. Another problem was created by the fact that some symbols stood for individual animals (e.g. penguins) while others referred to whole exhibits or buildings (e.g. Aquatic Birds).

Because only the familiar animals and symbols with words were correctly interpreted, we concluded that animal symbols have a limited ability to communicate, and the only way to eliminate confusion for the majority of visitors is to identify symbols with words.

What problems were visitors having with the existing mapboards? By interviewing visitors who were engaged in using the mapboards, we found that two-thirds of those sampled were having some problems using the map: mainly interpreting the symbols correctly. Other suggestions visitors had for improvement were to make the You-Are-Here symbol more clear; label (with words) the major exhibits; indicate which way was north; make landmarks more apparent (e.g., less abstract); and put the legend in a better place.

Visitors were randomly selected to be tracked for the first 10 minutes of their visit to see what methods of wayfinding they used. Twenty-six per cent of the sample didn't use anything. The most to least used devices were: mapboard, brochure (the free handout at the gate, which included a map of the zoo), and the directional signs. The low degree of wayfinding behavior by randomly-selected visitors was correlated with the high percentage of repeat visitors, data that has been confirmed by several demographic studies over the years.

Through the use of "exit interviews" we found what methods of wayfinding were most commonly recalled by visitors and what problems they'd had. Many of the suggestions for improvement were similar to data collected during the mapboard interviews reported above. Visitors also pointed out that they didn't realize that the free handout contained a map.

Decisions based on data gathered during the summer of 1983 included the following: re-do the free handout, and re-do the mapboard to include more words with symbols, less abstraction, more perspective (landmarks), and a more attractive, colorful format.

1984 Studies

Due to the large number of repeat visitors who knew the zoo well and did not have to make use of wayfinding devices, we wanted to get a larger sample of new visitors and focused our attention on the needs of first-time or infrequent visitors in the evaluations of summer 1984. By asking visitors "when was your last visit to Brookfield Zoo?" as they entered the park, we were able to identify first-time and infrequent visitors and request that they participate in a brief exit interview.

In interviews with frequent and first-time visitors, there were those from both groups who had problems or made suggestions for improvements. Complaints about getting lost or not being able to read the maps were not exclusive to new visitors; therefore, frequency of visits alone is not a measure of proficient wayfinding.

Mock-ups of new mapboards and prototypes of new activity schedules were tested that season with visitors for typesize and height placement, with particular attention to increasing accessibility. The old directional signs were removed.

1985 Studies

Near the end of the 1984 summer season the new mapboards were installed and a new handout was available. No new directional signs were up. In 1985, we wanted to know: How many people used the new kiosks (which contained the mapboard and show schedules)? (Figure 4). How successful was the new mapboard? How well was the new handout map working? Where were the critical "decision point" junctions where people needed orientation most? And, finally, what kinds of directional signs seem to work best? The plan was to make and test a variety of prototypes during the summer of 1985.

By watching the number of groups (loosely defined as a bunches of 2 to 8+ people who appeared to be travelling together as a "family," not including school or camp groups) who passed within an area nearby a kiosk and noting the number of groups who stopped at the kiosks, we discovered that close to 30% of the people were "attracted" into entering the kiosks. This surprizingly high percentage was confirmed by data from the exit interviews the same year (see below). The kiosk maps and schedules were bright colors and in a whimsical style to be attractive to young people, and many of the stops appeared to be initiated by a child in the group, so we felt that objective was being met.

Attracting power is only part of the story. How long did people spend in the kiosks, and what did they do? By observing groups as they interacted with the kiosk information and noting their behaviors and amount of time spent, we obtained a profile of typical behaviors. On the average, groups spent one minute in the kiosk; 20% spent over two minutes. Half of them read information outloud to each other, and more than half touched the maps and/or the schedules. These results were encouraging, because the kiosks had been designed to promote interaction and touching by visitors, young and old (Figure 5).

Observations of attraction and holding power still don't tell the whole story. We needed to know something about the quality of the visitor's experience with the kiosks, in their own words. To get these data, we engaged groups who were using the kiosks in brief, informal interviews.

"Hi, I work for the Zoo...We are interested to know if the map is clear? Were you looking for anything in particular? Can you tell which way the _______ are?" were some of the opening remarks by interviewers at the kiosk. Eighty percent of the visitors could point in the correct direction—a big improvement over the previous map. There were many positive remarks about the new mapboards, along with some suggestions for improvement. Judging from visitor feedback, we are confident that the mapboards are successful for the vast majority of the people who use them.

The same opening remarks by zoo interviewers (who included staff members of the Design Department, volunteers, and summer help) were used to engage conversation with groups who were in the process of using the handout map (Figure 6). From these interviews, we found that over 70% were trying to find something in particular and about 67% could point in the correct direction. Over 20% of those sampled found the handout confusing or hard to follow, usually because they were having trouble orienting themselves to the map, i.e., they did not know which way to hold the map so that points to the right corresponded with their right, and left was left, etc. Suggestions for improvement included "more detail," "simplify," "make it larger," "put a numbered key for the animal names," and to put directional arrows around the zoo. An updated version of the handout map (Figure 7) was printed during the 1985 summer which incorporated several of the visitors' suggestions for improvement, and subsequent interviews revealed fewer negative and more positive comments, but many of the same suggestions.

In the exit interviews, compared to the 1984 data, we found that mapboard use had more than doubled. Sixty-three percent of those sampled said they used the mapboards (in the kiosks), and the vast majority of the users felt the kiosks were well located and there were enough of them. Seventy percent said they used the handout (and there were no comments about not knowing they'd been given a zoo map), and although there were still some negative comment about the brochure there were more positive remarks, such as "good," "easy to use," and "no trouble."

In all of the interview samples to date we have found a small percentage of visitors who say they "aren't comfortable with maps." In addition, there are those who "prefer to wander" without concern for where they are. As noted before, many of the visitors to Brookfield Zoo are repeat visitors who are familiar with the park and "knew the way," but some other frequent visitor commented that "they always get lost." Wayfinding devices can be improved for most but not all visitors, and evaluation can help to minimize those who fall into the categories above.

Another portion of the 1985 studies addressed the issue of where and how many directional signs are needed. Thirty-seven different points around the zoo were checked to see how many groups of visitors passing by the area showed signs of "wayfinding behaviors," such as looking at their handout map, stopping and pointing/discussing directions (the classic "decision dance"). Figures ranged from zero to about 18 out of 100 groups who showed some wayfinding behaviors, with an overall average of about 7 out of 100. Points which ranked higher than the average are slated to receive directional signs first when they are installed next year, and further testing will determine if additonal signs are needed.

Four different prototypes of directional signs were tested this summer, with a variety of variations within each type (Figure 8). By watching for attraction and interviewing visitors as they looked at the signs, we came to the following conclusions:

- —Simple drawings attract attention better than more detailed ones
- —Words must be used with symbols
- —Each of the three of the new prototypes worked better than the old system of directional signs
- —Visitors wanted them and used them
- —High contrast is more important than bright colors for attraction, and green should be avoided (camouflage in a green park)
- —"Mash" style poles have the disadvantage of some planes being out of view at some angles (Figure 9)
- —Flat bands have the disadvantage of arrows pointing "up" for straight ahead, a feature confusing to some children and adults
- —Directions to the nearest restroom should always be indicated

In Conclusion

Through visitor feedback, we have verified that for the majority of zoo-goers the new mapboards worked beyond our expectations, and the new directional prototypes showed great promise. Future modifications to the handout will be made to increase its effectiveness.

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9

YOU ARE HERE

10

Next summer, when the new directionals are installed, a revised handout is being used, and with the success of the kiosk maps, we can have a high degree of confidence that our visitors will indeed know where "You are here" is.

Final Thoughts

Evaluation is not research; it does not employ the kinds of strict controls over variables that can reveal true comparisons between different methodologies and cause-and-effect relationships. Although it doesn't tell you why, evaluation does answer the immediate, pragmatic questions of "How well is it working now?" It is thrilling to see when things do work, and many arguments over subjective judgements are immediately eliminated when you see that something is not communicating—"It looks good to me, but the visitors didn't notice or understand it" noted one designer after testing a mock-up.

Technical Note: The emblem for You-Are-Here (Figure 10) on the new kiosk map was not embedded in fiberglass along with the rest of the map because the decision was made to leave kiosk locations flexible. This was not a good decision. No matter what glue, adhesive, bonding agent or "impregnable" coating used, visitors can remove the emblem, and it must be checked daily.

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Pictures, Paint & Print
Labeling as a Promotional Tool

Florence Bramley
Graphics Coordinator, Staten Island Zoo

The promotions and media coverage we spend so much time and expertise to develop create expectations for our public. Having read or heard about some delightful event at the Staten Island Zoo, visitors come to see the new stars, anticipating an enjoyable afternoon. Of course they see the identification label as well.

The Zoo public relations agency schedules a number of newsworthy events each year. Even in the dismal weather of early February Zoo news is created by promoting "Chuck", our resident groundhog, as New York's official weather forecaster. At other times of year he might be seen in a enclosure in the Children's Center. The label and a sleeping mound of fur are often all that the public sees.

Some of the more recent events which created important publicity for the Staten Island Zoo were: the steeple chase and winner's circle which celebrated the dedication of our pony stable, our welcome home celebration and later dedication of the Jalopy topiary memorial for one of the zoo's oldest residents, and the extremely popular adult Halloween party for which we turned our auditorium into a cobwebby cave complete with coffin for Zacherle, a famous local ghoul. People were dying to attend!

But what happens on the days when the fanfare is silent? What do our visitors see when they come to the zoo? Have we created false expectations with our creative promotions? Do the signs and labels intrude like billboards or offer appreciated information? Does the information the visitor receives--without benefit of trained docent, scheduled education program or even a supplementary guide book-- satisfy his or her need for a relaxed but stimulating experience? I am addressing these questions in reference to my own zoo, because I know it best. However, each of you can take a hard look at your own park and see how these questions apply to your situation.

When visitors come to the Staten Island Zoo they see a lovely park, a fifty year old building, a charming Children's Center, and construction from the roof to the cellar, inside and out. They also are delighted to see animals here, there and everywhere.

But the strolling visitor is also confronted with a plethora of labels and signs in a wide variety of colors, styles and typefaces. Our park is only 8 1/2 acres which means that the visitor could easily feel bombarded by distracting, uncoordinated graphics designs. A couple of years ago it became one of the priorities of the Zoo's Graphics Department to redesign the sign and labeling system. We studied publications by other zoos or about labeling. We took stock of our own resources. Then we began the long process of incorporating our new knowledge into the renovation of our labeling system.

As a first step, all outdoor signs are being put into these rustic, prefabricated frames. Helvetica has been chosen as the dominant typeface for all our signs, lables and printed materials. Eventually, all hand-lettered and engraved plastic labels will be replaced. We have been using our 3M ultraviolet exposure unit to create photo sensitive metal labels in-house at about 1/4 of the commercial cost. This summer we purchased a Kroy XL lettering system which has Helvetica fonts. It will eliminate the need to hand-letter one-of-a-kind signs on public view and also behind the scenes.

The job of coordinating our graphics is far from complete but we are pleased with the progress. By having made certain design decisions about type style, color, frames, and recently, length of text, we have been able to improve our educational message to the public. Eventually, visitors will see not only our "new" zoo with its animal hospital, aquarium, African Savannah, and Tropical Rainforest, but also a sign and labeling system which is a coordinated part of their recreational experience.

Before ending this presentation, I would like to show you some examples of well-designed graphics from a few other zoos. The Woodland Park Zoo in Seattle has a natural-seeming New England marsh where some of the labels are almost as unobtrusive as the camouflaged animals. The rule lines, color combinations, type faces and natural wood supports create non-intrusive design elements for the zoo's African Savanna graphics.

At the Cincinnati Zoo natural wood is again a predominant design element. Here too, limited color combinations and eye catching illustrations create appealing graphics. Many of which seem to nestle into the natural plantings of the park. I can't imagine a visitor to either Woodland Park Zoo or the Cincinnati Zoo coming away disappointed after having been lured there by some promotional event.

Many zoos and aquariums have good graphics systems. When design principles of simplicity and consistency are kept foremost, the result is interesting and informative graphics which compliment the animals that our visitors *really* came to see.

VISITOR EXPECTATIONS AND THE ALASKAN TUNDRA EXHIBIT

Jennifer Agnew
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In speaking to the "problem" of meeting the visitors' expectations, I would like to concentrate on one specific project, our Alaska Tundra Exhibit. Our intention was to have the visitors leave the exhibit with a better understanding of the nature of tundra. We wanted the exhibit to be an experience - or journey - that could impart a sense of vastness, the extremes and the wonder of the tundra. To get the word out to entice visitors, we tried various forms of publicity in which we used these themes. The different methods used were billboards, bus tails, posters, pieces in the local newspapers and television coverage. Later we added a short commerical spot.

It might be interesting to note how the public responded to these various forms of publicity. We conducted a survey at the exhibit and asked visitors if they had heard about the Alaska Tundra exhibit before their visit. Out of 60 polled, 38 responded yes, 22 no. Another question asked was "Where did you see or hear about the exhibit?" The answers were quite interesting, 15 responded they saw it on T.V., 12 saw the construction at the zoo, 8 the newspapers, 7 from family and friends, 4 saw the billboards, 2 the radio, 1 a brochure and 1 didn't know.

A separate survey was also conducted by a private company contracted by the Zoo. Their's was a gate survey in which respondents were interviewed at the main exit when leaving the zoo. They used in-person interviews with a sample of 534 zoo visitors. In this survey, those visitors who had seen or heard zoo advertizing and/or news items rated the Alaska Tundra exhibit the highest when asked what was their favorite exhibit. Fifty-one per cent of all visitors had heard about the Alaska Tundra exhibit prior to their visit. It was found that traditional media and word of mouth were the principal sources of knowledge regarding the Alaska Tundra exhibit.

So, the word is out, people are getting the message that there is a nifty new exhibit at the zoo. They hear it's about Alaska and they'll probably be able to see some grizzly bears and other new animals. Some people may have even picked up the themes, where we used descriptive phrases such as "the land of extremes", and may have gotten the idea we were doing more than just showing some new animals.

Back to the original question, "Are we meeting the visitors' expectations?" The visitor will come with certain expectations created by different public relation methods and their own expectations, based on personal experiences. Without getting heavily into the results of the survey, the results seem to indicate that the public likes the Alaska Tundra exhibit.

However, even though the public likes the new exhibit, are really meeting their expectations? On the surface, it would seem so. In actuality, I think it's a bit more complicated. After all, it is possible to leave an experience without all one's expectations met, and yet have positive feelings about the experience.

At this point I would like to talk about at least three levels of meeting expectations. The first I would call "meeting immediate needs." This includes such things as: are things working (such as the audio-visuals and hands-on interpretives), are signs readable, can the visitor see the animals? These are irritants which can have a definite way of discoloring the visitor's experience.

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The second level is an informational one. Are the visitors gaining anything from this experience? This of course, includes signage and other interpretives. I would also include being able to see the animals, or if not, letting the visitor know why. The enclosures themselves can be informational, especially if the animals are displayed in a naturalistic habitat.

The third level is the larger scope. This level deals a lot with emotions. How does the visitor feel when they leave the exhibit? Have they gained empathy for the animals viewed? Did they leave with a sense of wonder? Did they have fun? I realize that breaking visitor expectations down into three levels may still be a bit broad. For our purposes here, it helps to focus a little more on the various aspects of meeting expectations.

It seems to follow that if we meet the levels of immediate needs (level one) and the informational level (level two), the broader level will be met, and the visitor will leave feeling that they have gained something. However, something seemingly mysterious happens. If the visitors' overall experience is generally positive, some of the missing elements in the first two levels can be overlooked.

Well then, how did the Washington Park Zoo do with the new Alaska Tundra Exhibit? The surveys that I mentioned have helped us to look a little more closely at this question. As I mentioned, we did a survey at the exhibit. This was designed by the Education Division, using open ended questions in a naturalistic approach. A sample of 60 visitors was chosen at random. The responses to all the questions asked were really quite varied, running the gammut of the Alaska Tundra experience. As far as likes and what impressed people, even through the animals rated high, the interpretives were right up there, too. There seems to be just about something for everybody.

There were five questions on the survey that dealt with likes, dislikes, what was learned and impressions gained. With respect to the most liked aspect of the exhibit, the audio-visual presentation ranked a very close third behind the live grizzly bears and wolves. In answer to the question, "What did you learn?" some visitors were primarily entertained by the exhibit while others were newly enthused with the tundra and Alaska. For many, there were new experiences and new things learned. Responses to the question that dealt with impressions gained indicate the impression acquired of the Alaska tundra by visitors were mostly accurate, as portrayed in the exhibit.

The conclusion is that most of the public who saw the exhibit had their expectations met, with respect to what we tried to promote and anticipate. It is difficult to try to meet all the expectations that the public brings from their own experiences. We all try to do our best in anticipating those needs in accordance with what we are trying to accomplish with the exhibit. We can always do a better job in trying to meet the immediate needs of the public in making sure things work, panels are readable, animals can be seen. Often, this is a real learning experience for us. In designing the next exhibit we will try to expand upon what we have learned from the Alaska Tundra Exhibit.

The interesting thing about the Alaska Tundra exhibit is that the overall reaction has been very positive. This reaction comes in spite of problems such as downtimes with the audio-visuals, glare on the graphics, some animals not in view and other sundry or miscellaneous things. The important thing is not to take this positive feeling for granted. As I mentioned earlier, some of these minor irritants have a way of discoloring an experience. Enough of these kind of things and we've got real problems. Since the opening of the Alaska Tundra we've been working out the bugs and feel good knowing that our new exhibit has been well received by the public.

JA:PJ/19:16/

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New Education Awards and Guidelines 1985

Roger Yerke, Washington Park Zoo

In 1984 the Honors and Awards Committee reduced the number of education awards from three to one. In keeping with the enhanced significance of this single award the committee decided that the education award would be presented along with all other awards at the annual banquet instead of at the business meeting, as had been done in the past. The committee also recommended that the Public Education Committee review and refine the guidelines for the submission of education award entries and for the judging of those entries. The goal of such a review was to ensure that the guidelines were appropriate to the new status of the education award.

At the 1984 AAZPA National Conference in Miami the Public Education Committee conducted a workshop meeting with zoo educators and representatives from the Honors and Awards Committee to gather comments and recommendations on the entry and judging guidelines. Those recommendations were given to a sub-committee made up of Linda Wilson, Thomas Brennan, and Roger Yerke to assist them in the development of new guidelines. What follows is an explanation of those new guidelines and the rationale for their form.

The sub-committee identified two major areas of concern to be addressed in the design of new guidelines. The first of these was a need to facilitate the judging process. The number of awards applications judges are required to evaluate may number as high as thirty in any single year. For this reason it is important that entries be in a form that can be evaluated quickly so as to avoid creating a major time burden for volunteer judges. At the same time entries need to be in a form that allows the judges to easily apply the same evaluation criteria uniformly to all. Comments from those who have served as judges indicated past entries had varied so greatly in content and format that it was difficult to apply criteria consistently or that it was necessary to search through each application to find information relevant to various criteria. The sub-committee decided that the format and information required in entries should relate directly to the judging criteria.

Making the entry process equitable and understandable for all entrants was the second major concern. Workshop participants stated that the old guidelines were not sufficiently clear as to what information should be included in an entry and on what basis the entry would be judged. This was seen as a particular problem for first time entrants. It was suggested that the existing system favored those who has been able to learn the system after submitting entries for several years and those who had experience judging awards and who thus knew what material was most pertinent to the judging. This sitation contributed to the problem the judges had with entries which included large amounts of material that was not pertinent to the judging. Entrants unsure of what should be included in an entry, opted to include everything in the hope that would ensure nothing important was left out. The sub-committee recognized that it would be impossible and probably inappropriate to try to eliminate the advantage that comes from practice but that good guidelines could put all entrants on equal footing in terms of their knowledge of what is required in an entry.

The sub-committee looked to the standardized grant submission formats used by the federal government and many foundations as models for the new guidelines. These grant forms provide grant evaluators with submissions that can be quickly, consistently, and fairly evaluated. They also provide the submitters clear directions as to what is required of them. An additional advantage of the grant writing approach is that it allows, indeed requires, the submitter to clearly make a case for the significance of the submission.

A seven part entry format (A-G) was developed by the sub-committee. Each section has clearly stated information requirements and specified limits on the length of the information. The limits on length are intended to encourage well organized, concise, submissions. Section A is a standard cover page identifying the program, the institution, the submitter, and the program's initiation date. Initiation date had been a confusing issue in the past. The sub-committee decided to leave to the discretion of the entrant the question of when a program became permanent. Programs can now be entered during their development or the year development is completed and the program is offered on a permanent basis. This guideline is open to abuse but it is hoped that no one will choose to enter long running programs which are actually several years past their actual year of permanent implementation.

Section B is a half page summary description of the program. It serves a double purpose. Judges are provided with an introductory overview which makes the sections that follow more understandable on the first reading. The summary is also intended to be used as a way to publish brief information about programs entered.

Section C is a simple list of the program's objectives. Judges evaluate this section directly as to the clarity of those objectives. This information is also used by the judges in their assessment of the program's significance.

In section D entrants are asked to explain the significance of the program. This section is intended to provide the entrant with an opportunity to provide a case for their entry. This section is also evaluated directly by the judges.

Section E requires a narrative, maximum three pages, which describes program content, methods, and materials. Judges use this information to evaluate the program in three areas: applicability of the program to other zoos and zoo education in general, appropriateness of the content to the target audience and to zoo education, and appropriateness of the methods to the program's objectives and audience.

Section F requires a description of the methods used to evaluate the program and the results of that evaluation. Judges rate this section directly in terms of the evaluation results and whether or not the evaluation is pertinent to the program's stated objectives.

Judges do not rate the last section, G. This section is for the inclusion of supplemental materials such as printed pieces, slides, and tapes. An important requirement here is that any item included must be referenced in preceding sections. One problem with entries in the past was the inclusion of large quantities of supplemental materials whose relevance to the program in question was not always clear. Limits were also placed on the amount and the format of these supplemental materials.

Judges give scores to each entry for clarity of objectives, significance/value, applicability, content, methods and implementation, evaluation procedures, and creativity and originality. The applicable sections for the first six of these have already been mentioned. The last, creativity and originality, is based upon the judges' overall impression of all seven sections and their background knowledge of the field of zoo education.

Comments from the judges for 1985 and from entrants indicate that the new guidelines have made judging easier and equitable and entry preparation easier and more consistent. Some refinement in the scoring methods have been suggested. There have also been suggestions that entrants receive some feedback on their entries. The Honors and Awards Committee will address these in the year ahead.

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EDITORIAL NOTE

The following section contains the [illegible] sessions at the Columbus Annual C[illegible] submitted in different detail are [illegible] which consists of a detailed [illegible] nator Training Seminar convened at the [illegible] facility during the summer of 1984, [illegible]

The Columbus Annual Conference [illegible] at conducting a poster session, and [illegible] calls for another offering of [illegible] Kuenzer, co-chairmen of the Conference Program Committee.

[illegible]

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Report on the Development of the International Center for the Preservation of Wild Animals, Inc.

by Donald C. Anderson and Roger D. Hubbell

Currently, in Ohio, efforts are underway to develop a breeding and survival center for endangered wild animals. The project, called the International Center for the Preservation of Wild Animals, is being undertaken by a non-profit corporation made up of many prominent businessmen, conservationists and zoological professionals.

In 1978, the General Assembly of the State of Ohio created a Zoological Advisory Council for the purposes of promoting cooperation among publicly owned zoos in the state and determining the feasibility of establishing a wild animal breeding and survival area. The Council was made up of representatives of the publicly owned zoos in the state, parks, recreation and wildlife management professionals and political representatives. In its report to the General Assembly the Council stated ... "(a)fter careful and deliberate study, the Zoological Advisory Council has determined that a wild animal breeding and holding area is both necessary and feasible."

As a result of that recommendation, the Ohio Department of Natural Resources began the process of reviewing how best to develop such a facility in the state. The first critical step was to identify large blocks of land that could be devoted to the project. A number of sites were identified. Several were reclaimed strip-mined areas. Ohio is a major producer of coal. Since 1972, it has been a leader in the reclamation of mined lands. Though Ohio is a highly developed state, there were large tracts of reclaimed strip-mine land under single ownership that were not intensively developed. Department of Natural Resources planners identified one site as particularly well-suited for the Center.

The site is located near Cumberland, Ohio and is part of the Cumberland coal field, approximately 120,000 acres of land being mined by Central Ohio Coal Company under contract with the landowner, Ohio Power Company.

In August 1984, a non-profit corporation was formed with sole purpose of developing the project. It's structure provides for a 49 member Board of Trustees. Within that Board is an Executive Committee made up of 15 members. The Executive Committee has effective management control over the corporation. Eight of the Executive Committee members are at-large members; seven are members by virture of their positions at certain institutions. They are the Directors of the Cincinnati Zoo, the Cleveland Metroparks Zoo, the Columbus Zoo, the Pittsburgh Zoo and the Toledo Zoo, the Dean of the Ohio State University College of Veterinary Medicine and the Director of the Ohio Department of Natural Resources.

In November 1984, a planning workshop was held by the corporation at the proposed site of the Center. The purpose of the conference was to assemble recognized experts in zoo management, planning and strip mine reclamation as well as local representatives of agencies that would be involved in or affected by the project to:

° Discuss the potential for developing the project on stripmined land at the Cambridge, Ohio site.

- Discuss the objectives of the project.
- Discuss the issues that need to be addressed in the planning and economic studies to come.
- Familiarize local representatives and the planning team with the area and the project.

In general, the workshop participants agreed that the site was appropriate for the project and that the Center should be a comprehensive park-like facility designed to meet a number of objectives including the breeding and preservation of endangered wild animals, the education of the public to the plight of wild animals and the importance of habitat to the survival of life, research, and tourism. The workshop participants also established the information they felt would need to be developed through the planning process.

The specific overall objectives that have been established for the project are:

- Preserve endangered species of wild animals from all over the world and perpetuate them into the future.
- Educate the public concerning the importance of the land to the perpetuation of life including the survival of man himself.
- Educate the public as to how land can be used wisely for the benefit of man without destroying its ability to sustain life into the future.
- Introduce the public to other cultures from around the world and how they are dealing with the land and the disappearance of life forms.
- Provide a source of animals for zoos around the country, replacing the supply from foreign countries which is now being cut-off through embargoes.
- Provide a major and totally unique tourist attraction.
- Serve as a research center for the breeding and perpetuation of endangered wild animals and the study of their behavior.

The educational objectives are:

- Valuable life forms may disappear from the earth unless man makes a conscious effort to protect and preserve them and the land that supports them.
- Man can utilize the land for his own benefit but must respect and protect the land's capability to support life.
- All life forms that occupy the earth are mutually supportive. Man cannot carelessly destroy nature's ability to support life and believe that he will be allowed life, too.

- Animals can teach us much about ourselves.
- Cultures from around the world have a lot to say about the relationship of man to nature. We can learn from them and form a common bond with the rest of mankind to preserve life on this earth as we know it.
- We have a common heritage with those who occupied this land before us and we leave a legacy for those who will occupy it in the future.

The proposed site is shown on the map enclosed with this report. It is bordered by state routes 146, 340 and 284 and is approximately 7,000 acres in size. The land has been mined and reclaimed. It is gently rolling, predominately grassland with scattered woodlots, and many small ponds. The site has a very scenic pastoral quality. There is no evidence of severe erosion or sterile soil conditions. It is very close to the intersection of Interstates 70 and 77, two major east/west and north/south highways which make the site readily accessible to two thirds of the nation's population and the major population centers of Canada.

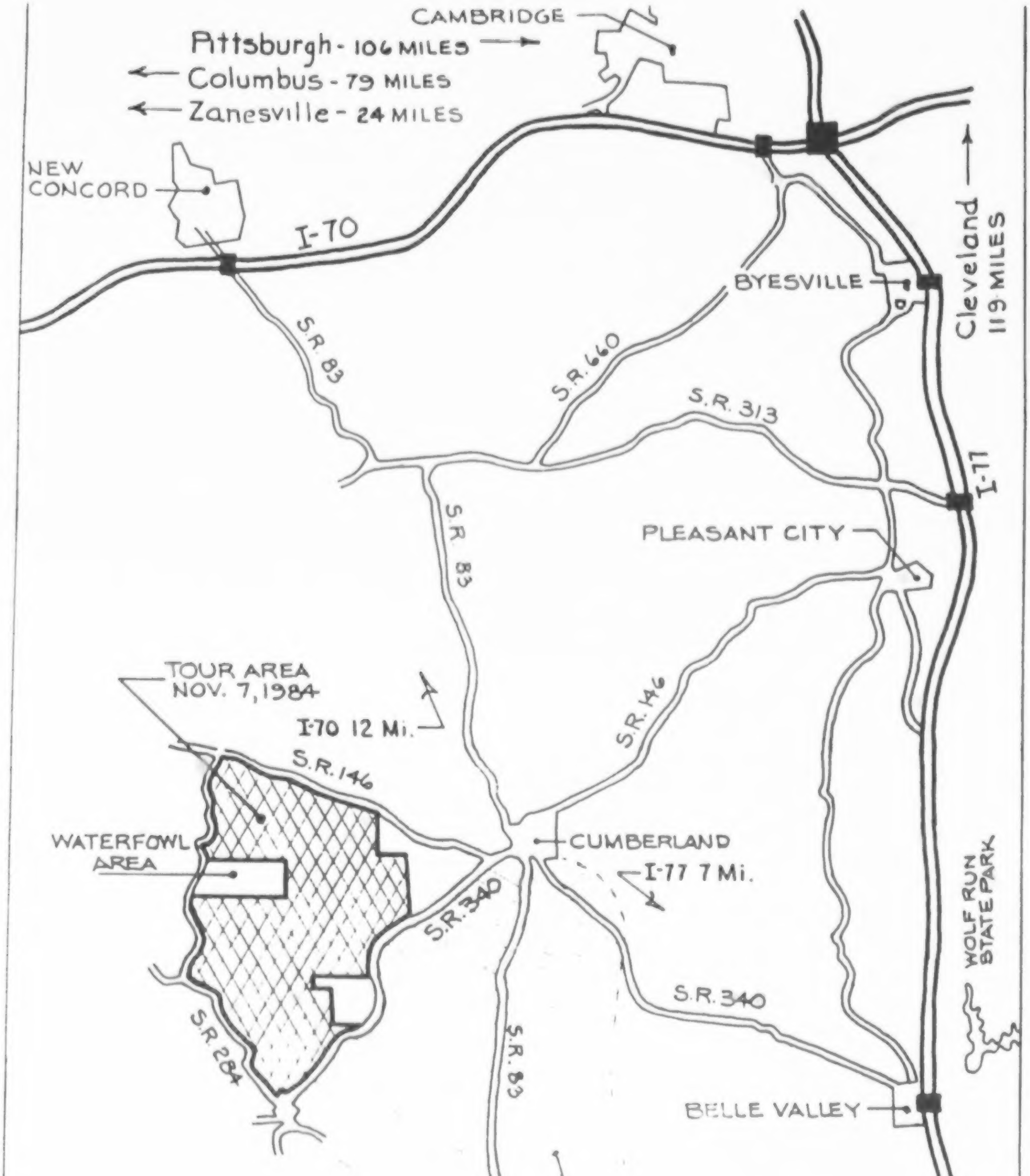
The land is currently owned by Ohio Power Company, a wholly-owned subsidiary of American Electric Power Corporation. Negotiations are currently underway between the Power Company and the non-profit corporation concerning a commitment of the land to the project. The form of that possible commitment has not yet been established.

The non-profit corporation has also established a $1 million fund-raising goal to pay for project planning, economic studies, organization and to develop a long-range fund-raising program.

The timetable for the project, assuming success with the land negotiations and fund-raising efforts is:

- Physical Planning & Economic Studies - completed July 1986
- Fund Raising for Development and the Preparation of Construction Plans & Specifications - completed May 1987
- Construction of 1st Development Phase - completed June 1988

The International Center for the Preservation of Wild Animals is being developed to help meet the very serious needs of wildlife preservation throughout the world. It is an ambitious project, one that will take many years to develop. But it will be an important part of the network that is developing to protect wild animals from extinction.


CAMBRIDGE
Pittsburgh - 106 MILES
Columbus - 79 MILES
Zanesville - 24 MILES
NEW CONCORD
I-70
BYESVILLE
Cleveland 119 MILES
S.R. 83
S.R. 660
S.R. 313
I-77
PLEASANT CITY
S.R. 83
TOUR AREA NOV. 7, 1984
I-70 12 Mi.
S.R. 146
S.R. 146
WATERFOWL AREA
CUMBERLAND
I-77 7 Mi.
S.R. 340
WOLF RUN STATE PARK
S.R. 340
S.R. 284
S.R. 83
BELLE VALLEY
OHIO POWER RECREATION LAND

Brookfield Zoo Group Sales

"A Commitment to Success"

Ted A. Beattie
Associate Director
Brookfield Zoo

Brookfield Zoo's Group Sales and Marketing Departments commenced 1984 and 1985 with a vow to build the Zoo's group outings volume. With capabilities for handling informal birthday parties, sporty picnics or lavish dinners for as few as 25 and as many as 4,500 people, the Departments felt they had a tremendous product to offer and only needed to commit to developing promotional materials.

To promote company outings, an unusual direct mail package was produced and shipped via UPS to presidents and personnel directors of firms with over 200 employees throughout the Chicagoland area.

All parts of the package were fun and served to convey visibly the message that the Brookfield Zoo would be a wonderful place to hold a company event. The interesting-looking box was intrusive enough to assure reaching the person to whom it was directed, and the hat was extrusive and attention-getting once it was on that person's head or desk.

As follow-up to inquiries generated by the initial mailing kit, a Group Sales folder with colorful brochure inserts describing facilities, rates and capabilities was developed and used in sales presentations.

One of the brochure inserts in the Group Sales folder is entitled "Birthday Parties" and contains information on Brookfield Zoo's menu, rates, scheduling and elements of a birthday party held there. This brochure was pulled from the folder and sent in response to inquiries generated by a black and white ad which ran (and continues to run) in area newspapers.

Response to the birthday party promotion has been very good. Comment sheets handed out following each party were returned, and generally spoke very well of the parties' food, the animal show, the Zoo "Aunties" who host the parties, and the overall friendliness shown the children by Brookfield Zoo.

Company outings also have increased dramatically in number and scope. They now range from casual picnics that include a tour of the Zoo to elaborate tented dinner parties featuring orchestras, gourmet food and glamorous lighting and decor for groups of more than 2,000.

Consignment ticket sales, another form of group sales, have grown from $2,500 in 1983 to $15,500 in 1984 and a projected $17,250 in 1985. Sales are gained from telephone solicitation, hat and brochure mailings and from the extensive use of billboards throughout Chicagoland from spring to fall each year.

BARRIERS: A WORLD APART

Debra A. Christensen
Potawatomi Zoo
South Bend, Indiana

Originally, zoos and aquariums were built to little more than house and exhibit the animals held in them. Today, most of our establishments are undergoing some form of renovation. In addition to physical expansion and rebuilding, educational and other special programs are growing as never before. As we build we are trying to establish a workable and enjoyable environment for both the animals in our care and for all of our patrons.

Until relatively recently in the histories of zoos and aquariums, the terms "barrier-free" and "total access" were not common. Like most of our society, we were unaware that our establishments contained different and sometimes hidden barriers that kept many people from totally participating in, or even coming to, our facilities.

People over the age of 65 and individuals with physical impairments often find that zoos and aquariums contain barriers that make their visits more of a chore than the enjoyable learning experience we meant it to be.

With our growing awareness of how barriers can exclude individuals from our worlds, zoos and aquariums are attacking the challenge of achieving total accessibility with vigor and imagination. In many ways, making our facilities totally accessible is more difficult than doing so to typical public buildings since we must meet the physical and psychological needs of not only our patrons but the animals we care for as well.

Barriers come in many forms, some not readily recognizable as even being such. Often eliminating barriers in our facilities cannot be accomplished by traditional means. What we will be discussing in this paper are some forms of barriers that may be found in zoos and aquariums and possible ways of overcoming them.

We have come to almost automatically to design our facilities so that stairs, high curbing, parking, bathrooms, drinking fountains and doorways are accessible and usable to all our patrons. Usually physical and other types of barriers can be overcome using conventional methods. Sometimes though, we come up against problems which cannot be handled by traditional means. For example, the problem of making your facility accessible to patrons who have physical limitations becomes almost overwhelming when your exhibits are spread out over the floor and wall of a valley or the sides of a mountain. Zoos are usually built over relatively large areas whose topography can vary greatly and aquariums are often housed in large, mutlileveled buildings which may have outside areas as well.

Due to the length, steepness or other difficulties to terrain, single ramps may not always be viable solutions to barriers posed by varying topography. Barriers can also be caused by the size of zoos and aquariums. The animals and exhibits our patrons are coming to see are usually not in a single room or even building, but spread out over a large area and often separated by assorted possible hazards. This means that the actual setting of our facilities can be barriers.

One way to overcome the problems of large size and difficult terrain is the use of modified tour vehicles. Buses and trains, in various forms, have been used for years by many of our establishments. Properly modified, these vehicles can give tours of entire facilities or be used to shuttle individuals between or through areas that are particularly difficult to reach or traverse. By combining vehicles that have low, easy access steps and wheelchair lifts and seating with carefully placed and marked "bus stops" in our establishments, we could open up even the hardest to reach areas.

Another way to lessen the problems of topography is to use multiple ramps and gradual surface grading. If you have exhibits that are on different levels, one solution would seem to be to join them with a single ramp. In some cases, the use of a single ramp will not eliminate a barrier but only change its form. A ramp which is too steep can be as unmanageable as stairs to persons in wheelchairs or those with other types of physical impairments.

One way to greatly reduce the problem of ramp steepness is to use several ramps joined by rest platforms to take steep gradients in stages. Dividing a problem slope into sections by using a system of multiple ramps, reduces the grade of incline of each ramp thus making the total slope easier to handle.

In many cases individuals over 65, those with physical impairments, and others may need to pause before continuing up a series of ramps. The use of platforms will allow patrons the opportunity to stop and rest before starting up the next ramp and allow them to take each incline at their own pace.

A single gradually rising path can also be used, in many cases, to make steep inclines and difficult terrain easier to travel. Here, as is often the case with multiple ramps, you are often increasing the total distance traveled. But, by lessening the grade of incline and detouring around difficult terrain, you are making the total pathway easier to travel.

In addition to its rate of incline and route, the width and surface of a pathway will also affect its accessibility. A highly contoured surface made of stones set in concrete, for example, may prove difficult for individuals in wheelchairs or with other physical impairments. An uneven surface makes steady, easy movement difficult. Every pathway needs to have a smooth surface which provides good traction for both pedestrian and wheelchair traffic. The width of the path should also comfortably allow the passage of both traffic types mentioned.

By making pathways totally accessible, we are opening our facilities to many whose movements before may have been impeded.

As mentioned earlier, the fact that our exhibits are spread over relatively large areas often creates a barrier in itself. Elderly and physically impaired individuals, as well as those with young children, and others, often need to stop and rest when engaged in physical activities such as prolonged walking. By placing adequate numbers of accessible rest areas throughout our establishments, we can virtually eliminate the barrier caused by size.

To be totally accessible, rest areas need to have spaces for wheelchairs and seating which facilitates sitting and rising easily. Some form of hand grips should also be provided to assist patrons who may have difficulty sitting or rising unaided.

The answers to how many rest areas a facility needs and what type of shelter they will require will depend on the size, topography, and needs of each zoo and aquarium.

By carefully planning and placing accessible rest areas throughout our zoos and aquariums, we are encouraging our patrons to take our facilities at their own pace. By making it possible for them to enjoy and continue their present visit, we are encouraging them to visit our facilities again.

At this time, millions of Americans have less than 20/20 vision, even with the use of corrective lenses. The causes of vision impairments vary, but no one is immune. By about age 30, everyone's sight will have begun to deteriorate to some degree. Virtually every person over the age of 65 will suffer some loss in ability to focus, resolve images, discern colors and adapt to changes in lighting.

Visual barriers are diverse and often very subtle and can affect individuals with other impairments besides visual ones. For example, walls, fences, shrubs and other means used to construct, separate and decorate exhibits and other areas can often obstruct the view of shorter individuals or those in wheelchairs. Allowances need to be made so that individuals in wheelchairs or others with physical limitations can easily approach and view exhibits, signs and graphic materials. The range of eye level viewing from a wheelchair is approximately 43" to 54" from ground level. If walls, shrubs and similar obstructions are kept below these levels, or if ramped viewing platforms are used to enable patrons to see over them, the viewing problems caused by these objects could be lessened to a great degree. Also, the height at which graphic materials are presented will affect how well they can be seen. Materials displayed at maximim and minimum reading heights of 65" to 54" will allow both sitting and standing patrons to easily see them. By controlling and limiting the height of certain objects throughout zoos and aquariums, we can lessen many forms of visual barriers.

Other factors in addition to viewing height effect how well materials will be seen. Contrast, lighting, crispness of edges, color combinations, print size, style and viewing distance all interact with each other to affect a material's visibility.

Ideally, we need to test graphic materials under the actual conditions they are to be viewed, for materials that work well in the shop may be virtually unreadable under actual display conditions. For example, dim lighting or glare at the display site can decrease the contrast between images and their background, thus causing legibility to decrease. What we want, ideally, are graphics that use high contrast images that have crisp edges that will be viewed under optimum lighting and viewing distance. If we design graphic materials so that all elements of seeing interact with each other to maximize legibility, we will increase the accessibility of these materials to all patrons.

Maps and other printed materials are often provided to patrons to help guide them through our zoos and aquariums. In addition to giving the usual information on the location of exhibits and special events, these materials should also indicate the locations of accessible washrooms, entrances and exits, pathways, special tours and other facilities or accommodations that patrons may need.

If these materials are presented in normal sized type, they may be unusable to many individuals who are visually impaired. But when offered in large type, these materials can often be effectively utilized by these same individuals.

Another way to open our establishments further is the use of audio cassette tours which describe the various exhibits and graphics. These materials could be made available at the main entrances of our facilities or at vairous other designated locations. Individuals who need to use these special materials could pay a nominal fee or leave some form of security deposit that would be returned when they handed in the cassette and player.

The use of audio cassettes, large print guide materials, and clear, readable graphics will increase our accessibility to many with visual impairments.

Hearing impairments are often called the "hidden handicap", for individuals with this disability usually lack any obvious features such as a white cane or wheelchair. For over 15 million Americans, less than half of whom are 65 and over, the ability to hear is significantly impaired.

Most zoos and aquariums offer tours and lectures to the public. For these, and similar functions, we need to control noise as much as possible for it interferes with the dialogue and decreases the understanding of the audience. Also, narration given with good diction, clear tones in the lower registers, spoken neither too quickly or slowly, measurably increases the ability of the audience to hear and understand.

Offering tours and lectures with special sign language or oral interpreters for both the hearing and visually impaired will also increase our accessibility. These special lectures and tours could be arranged by appointment and to proper interpreter for the individuals' or groups' needs could be secured. These interpreters could be specialy trained members of our own staffs or trained individuals from outside our facilities. It does not matter where these interpreters come from. What is important is that they are familiar with our establishment and the material to be presented and that they are also comfortable with and trained to meet the needs of the special individuals they are to interact with.

Increasing our accessibility extends also to our educational and special programs. The limitations which our older patrons may possess vary greatly from individual to individual, and those of our patrons with different physical impairments vary not only between individuals but between each type of impairment as well.

Tailoring educational and other programs for each group's requirements takes a great deal of time and awareness of their unique needs. The use of touch tables, braile and large print materials, descriptive narration, special tours and physical activities, oral and sign language interpreters and other specialized criteria have greatly increased the accessibility of educational programs to date. As we continue to refine existing programs and create new ones, we will find ourselves reaching and involving new segments of our populations more fully in our facilities -- segments that may never have been able to totally participate before.

Training staff members to interact comfortably with and meet the needs of physically impaired individuals is important. Often people are unsure how to react to a person who is disabled in some way. For example, when speaking with someone who is blind, we sometimes shout or, if they are with someone else, we will refer our questions to their companion. In our discomfort we seem to forget blind is not deaf. We all need to develop guidelines and good understanding of each group's needs and abilities if we are going to successfully interact with them.

Volunteer and other similar programs give us the opportunity to expand the resources of our zoos and aquariums while involving our patrons in our facilities.

Individuals with visual, hearing, or other physical impairments can participate as tour guides, narrators, lecturers, teachers, and teacher's aides and in countless other aspects of volunteer work as well after they have undergone the required training. These individuals cannot only help us through their volunteer work, they can also give us a first-hand account of how truly accessible our facilities are and how we can open them even more. In addition, these individuals can help us reach others, for they understand first hand what individuals with similar impairments may need or have difficulty seeing or doing. Through their special abilities, talents and insights, these individuals can help others to enjoy our establishments as they have come to do.

In regard to our older patrons, over 23% of all persons age 65 and older devote time and energy to volunteer work. These individuals represent a lifetime of learning, ability and experience and often the time and willingness to share what they know and learn more. These people are a gold mine of talents and abilities that could greatly add to our resources.

By increasing the accessibility of our different programs, we will also increase the number of people whose talents, learning, abilities and unique outlooks will be working to better our zoos and aquariums.

There are steps we can take to help us discover barriers before we build and to effectively remove those already in existence.

Discussing our barrier problems and sharing possible solutions with other zoos, aquariums and similar institutions such as parks before we build increases our efficiency in eliminating barriers. Also, by talking and working with organizations experienced in working with the groups we are trying to reach, as well as with individuals in these groups, we can better design our programs and facilities.

Communication, planning, testing, and an awareness and understanding of the needs of our elderly and physically limited patrons are the keys to making our facilities barrier-free. Zoos and aquariums have done much to increase their acessibility and are continuing to work for total access. If we do fail to remove barriers and to meet the needs of our special patrons, we will lose not only their presence in our facilities, but their support as well.

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THE EXHIBIT DESIGN FORM: A tool for successful exhibit designing

Diane C.M. Forsyth
Curator of Education
Akron Zoological Park

When creating exhibits, three main catagories are considered. The animal to be exhibited, the publics ability to view that animal, and the keepers access to the exhibit. Completing these three objectives in an exciting, creative, economical fashion is every exhibit creators objective. To assist you in achieving these goals in a manner far more efficient than you have previously encountered, may I present a new tool, more specifically a designing template, The Exhibit Design Form.

Used in conjunction with the typical designing tools and experts, the Exhibit Design Form promises to bring into your design brainstorming sessions an entity that until recently was frequently neglected and saddely ignored. That element, the keeper, is a useful and irreplaceably important entity to any exhibits ultimate success.

Consider for a moment a beautifully designed exhibit for the animal of your own imaginary choice. The public is enthralled with the splendor of the landscaping. Awards are won for the superior design and the fascinating graphic explanations concerning the animal in its natural state. The accolades seem endless until a discussion is carried out with the exhibit's keeper who spends countless hours cleaning an exhibit that has a gradual slope leading up to the drain. Or perhaps that keeper, during the normal course of a day, has to crawl on hands and knees to view through a too low shift door to ascertain the whereabouts of their charge. Complaints such as these are easily overcome through the use of keeper input in an exhibits' design.

Gathering the information that a keeper has about his or her enclosures and the animals within, has gone little further than the daily and weekly reports tha all of our zoos collect. Journals, miscellaneous articles and anecdotes, and papers presented at AAZPA and AAZK conferences round out our written keeper information. What a keeper has learned through the experience of working daily with his or her charges is a valuable and useable designing tool. The Exhibit Design Form has been created specifically to pool together this wealth of knowledge into a concise, easily read designing form. Use of this form will become clearer as we look at its individual parts.

The very first section of the form addresses itself to the basic information at hand. Identifying the species being discussed, the contributor of the information, the zoo from which the design if from, and other pertinate basics covers all necessary formalities. The body of the form begins with the topic of Enclosure Specifics. Within this topic, a fully diagrammed description of the enclosure being discussed is requested. The contributor is asked to identify both the advantages and the disadvantages of this enclosures' design and to provide the same information on the design of the shift and/or off exhibit areas of the exhibit. Additional information on techniques used for shifting, special design features of the off exhibit areas, and a description of the number and type of inhabitants exhibited round out the information available through the completion of this section.

The second area within the body of the form is covered with the title, Species Specifics. Routine medical treatments, recurring medical problems, animal handling and the reasons for such handling, and a brief description of the diet being used within the enclosure are covered in this section. Though not intended as a keepers chance to diagnose the ails of his or her enclosure inhabitants, a clear picture of the medical problems encountered within an exhibit may point out pitfalls to be avoided when design of a similar enclosure is undertaken.

The final section of the Exhibit Design Form addresses the needs of the Keeper Specifics. This section above all others should reveal important design information. Suggestions for keeper and animal safety includes information on the special techniques used, the noticeable flight distance of the species in question and other pertinent information that a keeper deals with daily. A discussion of the husbandry tools used (including manufacturer and purchase information) is of obvious use to us all. The request for an analysis of the degree of maintenance effort that is required for the upkeep of the exhibit should prove to be an interesting addition to a salary concious designer.

This quick analysis of the form and the information it provide should start a creative designers' wheels turning. Now tha we have this form, what do we do with it? As originally conceived, the form was to be offered for use to zoos who needed to find out information on designing an exhibit. It was to be suggested that the interested zoo (the requesting institution) would submit a blank Exhibit Design Form to a zoo already maintaining an exhibit on the animal in question. This zoo (the contributing institurion) would complete the form, keep one copy for their own files, and mail the other two copies to the requesting institution. Now the requesting zoo has the necessary information and can send the third copy to the collecting institution who will begin the maintain a collection of all completed forms. Complicated as all of this sounds, it still remains the main emphasis of the Exhibit Design Form.

Further analysis reveals a myriad of uses for this versatile form. The most obvious is the easy use of the Collecting Institution (The Akron Zoological Park, 500 Edgewood Ave., Akron, Ohio 44307 presently serves this function) as a quick means of obtaining information from several zoos at the same time. Requesting the use of the form in conjunction with conferences offers a new and uniform way to exchange information pertinent to the matters at hand. Routinely completing a form on all new exhibits at your zoo will not only ease the hours necessary to complete the form, but will assure your zoo's representation at the Collection point. What better way to contribute then to make available your design techniques to other interested design artists? Lastly, the Exhibit Design Form may become useful to researchers searching for fine details to add to their informational files. The possibilities for the form and its information appear to be limited only to our own lack of experience using it!

Consider the Exhibit Design Form before your next enclosure is created. This tool can only be tested through continued use, and will only serve its purpose if put to that use! Your individual assistance in formaing a solid collection of available completed forms will assure each of our individual designing successes. In a profession such as ours, sharing information and learning by helping are essential ideals for the success of goals such as AAZPA and AAZK have set forth for their members.

NOTE: The exhibit Design Form is a new project sponsored by the American Association of Zoo Keepers. For more information on the form or to obtain forms, free of charge contact:

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A REVIEW OF THE CONSIDERATIONS FOR THE DESIGN AND CONSTRUCTION OF THE COLUMBUS ZOO GORILLA COMPLEX

By

Dianna J. Frisch
Headkeeper, Great Apes
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In 1982 the Columbus Zoo was housing eight Lowland Gorillas (*Gorilla g. gorilla*) in two facilities which were separated by a large grassy area.

Ape House North (renovated in 1978) included one large inside playroom constructed of gunite walls and rockwork, a waterfall, and a glass-fronted public aisle. The building also contained two small back holding areas. Surrounding 75% of the outside of the building is a moated area with grass, trees, a waterfall, and a large recirculating pool.

Ape House South was originally built in the late 1950's. Great Apes were exhibited in small bar-fronted cages. Public viewing was provided by a large glass-fronted aisle on the south side of the building.

As the Columbus Zoo's breeding success increased and the lowland gorilla collection began to increase in number, additonal space was needed.

Working with a budget of approximately $750 thousand it was elected to construct a large open-air habitat. It would connect the two inside facilities forming a large interconnecting complex.

It was decided that no structural changes were to be made to Ape House North. A tunnel connecting the moated north yard to the outside habitat was installed. Access to the tunnel is controlled by steel air-powered doors. The tunnel allows gorillas to be moved throughout the entire complex,eliminating the need for sedation during this process.

The new outside habitat is modeled after John Aspinall's gorilla facility in Howletts Park in Canterbury, England. It reaches a maximum height of 30' and is constructed of steel mesh with two centralized towers for support. Inside the sod-based enclosure are many varied-level platforms and a suspended S-shaped catwalk. Cargo ropes and rope hammocks provide activity stimulus for the animals in the 1821 square meters of space inside this habitat. Six glass panels provide zoo visitors with a close-up view of this species.

It was decided to renovate the inside animal areas in Ape House South. The renovation involved the removal of the front bars. This extended each animal area, thus doubling the amount of available inside animal space. The new enclosures were formed from steel mesh and equipped with air-powered doors, skylights, new fluorescent lighting, large overhead chutes,and ropes for play. Public viewing inside the building was eliminated. Animals are moved in and out of the building on a rotating basis through the long overhead chute into the habitat.

At the time of this writing the facility has been in use for 16 months. Its success is apparent from many standpoints. An increase in preferred behavioral actvities has been noted. Breeding activity has increased since the animals have been housed in the new complex. Public response to the facility has been enthusiastic. Zoo visitors view the animals at close range, at eye level (if the animal chooses this level), with minimal barriers to inhibit their visit. Keeper staff has found the facility to be very practical in its design features. The design permits keepers to easily observe, maintain, introduce, translocate, or modify social groupings.

(The final architectural design completed by Jane Shapiro, architect, Columbus, Ohio.)

Genetic Identification Of A Hybrid Animal

Edward J. Gentz and Terry L. Yates
Department of Biology and Museum of Southwestern Biology
University of New Mexico, Albuquerque, NM 87131

The Camelidae are the most important mammalian herbivores native to South America. There are two wild forms, the guanaco (Lama guanicoe) and the vicuna (Vicugna vicugna). The llama (L. Glama) and the alpaca (L. pacos)are domesticated forms, domestication ocurring between 5500 and 8000 years before present. Both have been selectively bred by man since this time to accentuate different traits. Llamas have been bred for pack animals while alpacas have been selected for high quality wool. All four forms hybridize naturally, with the hybrids fertile both among themselves and in backcrosses to the parental type.

After a long embargo on imports of South American camelids, North American zoos in 1984 had the first opportunity in many years to purchase recently exported animals. The Rio Grande Zoo, in Albuquerque, New Mexico, obtained three of these animals, one of which appeared phenotypically intermediate between a llama and alpaca. Variation in external morphology and the fact that llamas and alpacas have identical karyotypes (2N=74) as well as the same C-banding pattern in differentially stained karyotypes makes positive identification to species difficult.

The Rio Grande Zoo approached the laboratory of Dr. Terry L. Yates to assist in the identification of this suspect animal. It was hoped that modern cytogenetic and biochemical genetic techniques could identify this animal.

Blood samples from five llamas, two alpacas, and one unknown camelid were obtained from the Rio Grande Zoo and various private owners in Albuquerque, New Mexico. Samples were analyzed using starch gel electrophoresis.

Electrophoresis is a process by which an electric current is passed through a series of homogenized tissue samples imbedded in a starch gel. This causes the proteins making up the tissues to migrate differentially through the gel, depending on the size of the protein molecule and its net charge. Variation between individuals in the migration pattern of similar proteins reflects presumed genetic differences in the underlying makeup of the proteins.

Of the 24 presumptive genic loci resolved in this study, the llama and alpaca samples were identical at all but two. At the glucose-6-phosphate dehydrogenase locus (G6PDH), the llamas all had slow allele A while the alpacas all had the faster allele B. At the leucyl-alanyl peptidase locus (PEP-LA), the llamas all shared a common allele that was entirely absent in the alpacas.

The suspected hybrid had both the A and B G6PDH alleles present, which is what would be expected of a hybrid at a monomeric locus (AA x BB = AB). At the PEP-LA locus, the suspect animal showed no intermediacy and shared the null allele with the alpaca samples.

These data suggest that the animal in question is of hybrid origin at the F_2 generation or beyond, that is, the suspect animal is the result of a llama-alpaca hybrid backcrossed to one of the parental types.

It is well known that the Hamburg line of the Przewalski horse was tainted by a domestic horse hybrid in the past. The application of these and related techniques to zoo management will help preserve the integrity of historical lineages, especially those below the species level such as subspecies.

THE ZOO AS A LEARNING LAB

GLAZA/Los Angeles Zoo

The Greater Los Angeles Zoo Association and the Los Angeles Zoo take great pride in their dedication to all facets of education. The photo essay depicts the combined efforts of the Docent Committee and the Zoo staff in this endeavor.

Under the guidance of the Education Committee composed of qualified curriculum representatives from both the public and private school systems the Docent Committee (438 volunteers) designs, develops and implements programs to reach the entire community. Docents, Zoo Guides and Student Volunteers - the three divisions of the Docent Committee - toured over 33,000 students in grades 3-12 and reached over 20,000 students via outreach and special programing in 1984-85. The Docents also participate in many other activities which benefit the Zoo and the Zoo visitor such as on-going training in zoology and animal handling, behavioral observation research studies and data tabulation, and development of materials for special events.

Special programs for special people provide in-depth knowledge and a closer look at the Zoo and its role in conservation. Zoo visitors meet animals face to face at DISCOVERY CIRCLE. Organized youth groups earn patches at one of three levels after completing the four-hour Zoo course and follow-up activities in the ZOO WORLD PATCH PROGRAM. Over 300 high school students from Los Angeles Unified School District attend the BIOLOGICAL SCIENCES MAGNET SCHOOL on Zoo grounds where they have constant reinforcement of curriculum by contact with Docents and Zoo Staff. ANIMAL INFORMATION TABLES provide the zoo visitor unusual ways to learn: self-quizzes, dressing up, and handling of models and specimens. Tactile and multi-sensory programs for all ages of handicapped persons are provided in the I'M EXCEPTIONAL PROGRAM.

Outreach programs touch many people who might not otherwise be able to attend the Zoo. SENIOR SAFARI, the newest program, takes the world of animals via slides to senior citizen centers and retirement homes. Students discover the BIOMES OF THE WORLD through five Docent visits to their classroom. Live animals delight children in both the ZOOMOBILE and HOSPITAL PROGRAMS.

Public education introduces visitors to the Zoo via several different graphic display systems and animal shows. Hand-painted tiles identify animals and provide valuable information at each exhibit. The 1984 summer Olympics and loan of giant pandas from China allowed development of special activities and graphics designed to orient the public to the marvels of the animal world. Cartoons are eye catchers on the endangered species graphics which discuss conservation programs and animal management. The crowd-pleasers, the "World of Birds" and the

Combined, the Zoo's education programs reach a multitude of publics enhancing their appreciation and understanding of the wildlife of the world.

Photo Credits: Bart Bartholomew/Black Star, Harlan Deckert, Neal Johnston, Debbie Mills, Harvey Newman, Dorothea Petrula, Jalien Tulley.

THE LOS ANGELES ZOO
GLAZA
LA ZOO

REPRODUCTION, SEASONALITY, AND INBREEDING IN CAPTIVE BROW-ANTLERED DEER

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INTRODUCTION

The North American population of Brow-antlered or Eld's deer (*Cervus eldi*) has been bred in captivity since 1969 in four North American zoos: Bronx, Miami, National, and San Diego. All deer are of the subspecies *C. e. thamin* and were imported from zoos in Rangoon, East Berlin and Leipzig. The founder stock of 6 males and 10 females has steadily increased to its current level of 39 males and 48 females.

OBJECTIVES

Our objectives were to investigate:

1. Birth season in a tropical deer bred in a temperate environment.
2. Reproductive characteristics of the captive U.S. Eld's deer population.
3. Degree of inbreeding in the captive population and its possible effects.

MATERIALS AND METHODS

Breeding records from Bronx, Miami, National and San Diego were analysed to determine conception dates, interbirth intervals (IBI), sex ratio, fecundity, neonatal characteristics and birth season. Birthweights were collected at Miami and National zoos only. Records of Paris-Vincennes births were analysed for birth seasonality. Conception dates were determined by backdating one gestation period (242 days).

REPRODUCTIVE CHARACTERISTICS

Females first conceived when they reached 15 months. Gestation averaged 242 days and most females gave birth every year with the interbirth interval averaging 379.2 days. Single births were most common. Twinning occurred rarely but no twins survived. Sex ratio of all captive born was 0.86 males : 1 female. Birthweight averaged 4.85 kg for males and 4.75 kg for females and did not significantly differ. Reproductive rate was high; 90% of reproductive age females produced fawns, 66% of these fawns lived to one year of age and 23.5% died in the first two weeks of life. Captive does have produced up to 9 consecutive fawns.

INBREEDING

Inbreeding coefficients were calculated for all individuals in the captive U.S. population. Inbreeding coefficients were lower among deer living past 1 year than deer dying before 1 year of age, however, this trend was not signifigant (t-test). The average inbreeding coefficient was plotted for all fawns born at each zoo per year. Results showed a slight increase in inbreeding since 1982 for both Miami and Bronx zoos.

BIRTH SEASON

In U.S. zoos average birth date was October 22 with births ranging between July 22 and March 13 (n=158, 1969-present). U.S. zoos, with latitudes ranging from 26 to 41 degrees North, showed no significant differences in birth season for Brow-antlered deer. Also there were no significant differences in birth season between the U.S. zoos and the Paris Vincennes zoo at 49 degrees North latitude.(n=144, 1937-1980). The Paris-Vincennes zoo birth season was slightly longer, lasting from June 6 to March 24. A population at the Bronx zoo early this century (n=23, 1905-1919) showed a considerably later birth season than found today in any of the U.S. zoos (ANOVA; Duncan's new multiple range test, $p<0.01$) Their birth season ranged from September 17 to March 7 with the mean date being November 24. Past management practices of this old Bronx population could be a cause of this difference. However more detailed records are necessary for an explaination for the shift.

DISCUSSION

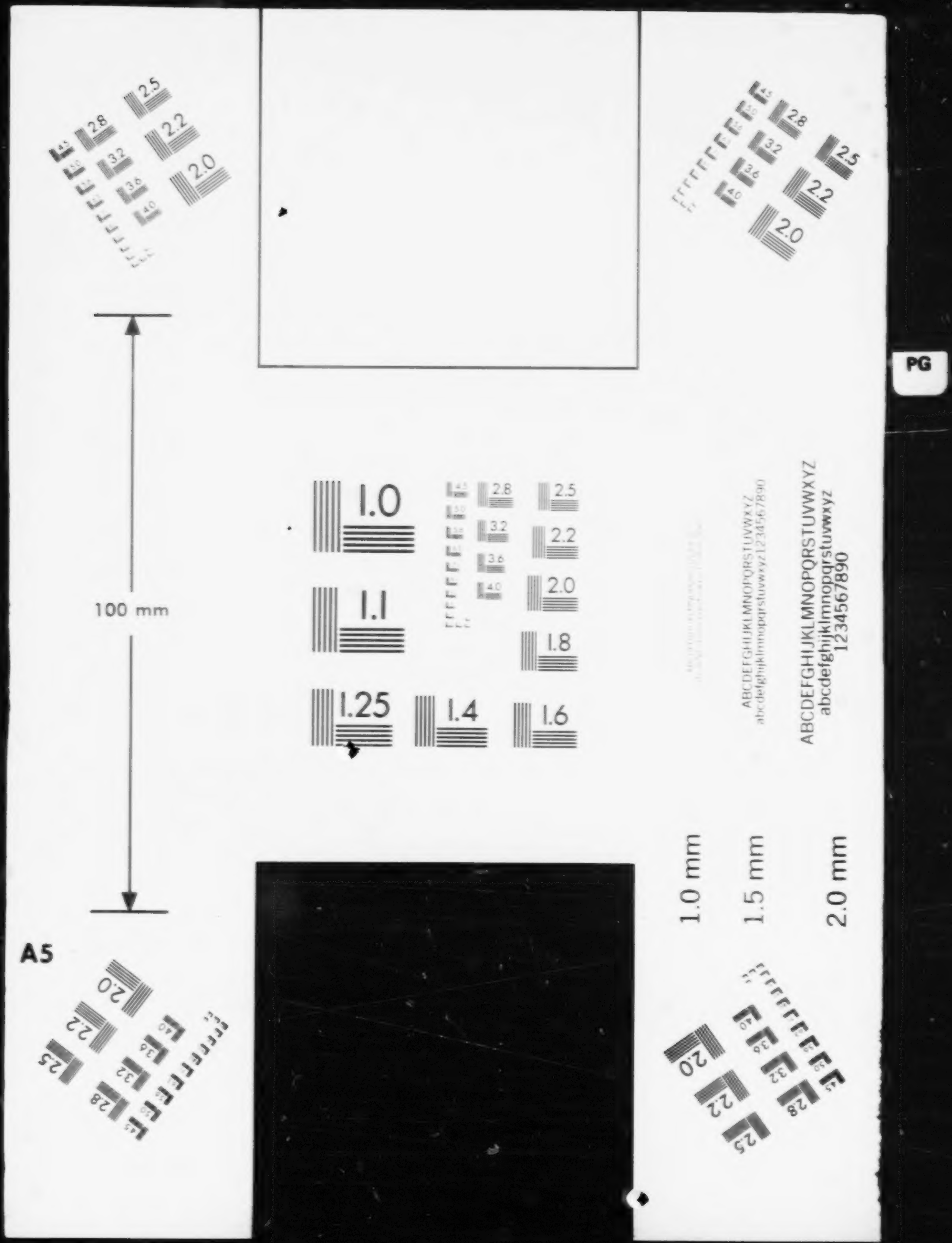
At 242 days Eld's deer gestation seems long when compared with other deer of similar size. White-tailed deer gestations were 199 days when fed on a high plane of nutrition. The distinct seasonality of fawning periods in the U.S. population synchronizes births at a disadvantageous time of the temperate zones beginning of winter. When fawns were born later in the birth season, survival rate decreased. In Rangoon, Burma where most zoo stock originates the same periodicity would sychronize with the end of the monsoon rains, the start of new vegetational growth and favorable forage conditions.

Brow-antlered deer breeding seasons differed little between the four North American Zoos. Only the old Bronx population showed significantly later timing of births.

Inbreeding coefficients of captive born Eld's deer seem to be increasing lately because of exclusive use of a small number of breeding males. A more structured inter-zoo breeding program may become neccessary.

ACKNOWLEDGEMENTS

We wish to thank John Ballou and Judith Block (NZP), Marvin Jones (SDWAP), Frank Rivera (Miami), and Dan Wharton (Bronx) for providing and updating records on their respective zoos and Marvin Jones for providing records on the Paris-Vincennes zoo. We specially thank John Ballou who provided and helped run the program for the calculation of inbreeding coefficients, and all FONZ trainees and volunteers at the Conservation and Research Center who helped collect and analyse the data.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THE CONSORTIUM OF AQUARIUMS, UNIVERSITIES AND ZOOS

Dr. Donna FitzRoy Hardy, President
Consortium of Aquariums, Universities and Zoos
c/o The Department of Psychology
California State University, Northridge
Northridge, CA 91330

On April 26, 1985, a group of 25 people from various zoos, universities and one aquarium met at California State University Northridge to discuss the feasibility of forming an organization which would serve as a formal link between the educators and researchers at universities, zoos and aquariums. Enough interest was shown at this meeting (and by an additional 26 people who were unable to attend) to make the decision to hold a general meeting on August 21, 1985. An Ad Hoc Steering Committee was brought together to plan the August meeting. This group was composed of representatives from the Los Angeles Zoo, Santa Barbara Zoo, Santa Ana Zoo, Marineland, California State University Dominguez Hills, C.S.U. Los Angeles, C.S.U. Fullerton and C.S.U. Northridge. Dr. Donna FitzRoy Hardy (C.S.U. Northridge) served as planning coordinator for both the April and August meetings, and distributed invitations for the August meeting to more than 200 university, zoo and aquarium people. Letters of support for the formation of the Consortium were received from many people, including those associated with the American Association of Zoo Keepers, the National Zoological Park, the New York Zoological Society, the School of Veterinary Medicine at the University of California, Davis, the Zoological Society of San Diego, the San Antonio Zoological Gardens and Aquarium, the San Francisco Zoological Society, Woodland Park Zoological Gardens (Seattle), the California Living Museum (Bakersfield), the Monterey Bay Aquarium, Marine World/ Africa USA (Redwood City, CA), the Florida State Museum/ University of Florida, the Santa Ana Zoo, Sea World/Hubbs Marine Research Institute (San Diego), the University of Akron, Wayne State University, Audubon Zoological Garden (New Orleans), the Dallas Zoo, Jacksonville State University (Alabama), Kansas State University, the Arizona-Sonora Desert Museum (Tucson), the Oklahoma City Zoo, Pomona College (CA), California Polytechnic State University (San Luis Obispo), the Los Angeles Zoo, the Greater Los Angeles Zoo Association, C.S.U. Los Angeles, the University of California, Irvine, Marineland (Rancho Palos Verdes, CA), the Santa Barbara Zoological Gardens, The Living Desert (Palm Desert, CA), and UCLA.

The first meeting of the Consortium of Aquariums, Universities and Zoos (C.A.U.Z.) was held on Wednesday, August 21, 1985, in the Faculty Center at the California State University, Northridge, with Dr. Donna FitzRoy Hardy presiding. The 62 people who attended respresented zoos, aquariums and universities throughout Southern California. The institutions represented included the Los Angeles Zoo and the Greater Los Angeles Zoo Association, the San Diego Zoo, the Santa Barbara Zoo, Washington Park Zoo (Portland, Ore.), the Los Angeles County Natural History Museum, Marineland, the Gibbon and Gallinaceous Bird Center (Saugus, CA), Cabrillo Marine Museum (San Pedro, CA), the Living Deserve Reserve (Palm Desert, CA), the University of California campuses at Los Angeles, Irvine, San Diego and Davis, and the California State University campuses at Northridge, Los Angeles, San Luis Obispo, Fullerton, Dominguez Hills, and the Los Angeles Unified School District as well as Active Environments, Inc. (Behavioral and Presentation Consultants) and the Jungle Exotics Study Program (Nonprofit Wildlife Education Corporation). The group voted to form the Consortium, to have the organizing committee (the Steering Committee) serve as the Executive Committee until bylaws are written and passed, and to have Donna Hardy act as President of C.A.U.Z. Dr. Terry Maple (Professor of Psychology at the Georgia Institute of Technology, Director of the Atlanta Zoo and editor of Zoo Biology) spoke on the topic "The Relationship Between Zoos and Universities from the Perspective of the Zoo Director" and Dr. Robert H. Suzuki (Vice President for Academic Affairs at California State Univesity Northridge) spoke on the topic "The Relationship Between Effective Teaching and Research in the Academic Community." Both talks were very well received by the meeting participants and stimulated the general discussions of the need for the Consortium, its function and organization. Ideas that were shared included the need for teacher training at all levels, the sponsoring of courses and workshops for students and zoo keepers, the need for a centralized bank of educational materials for use at zoos and aquariums, the opportunities for collaborative projects and joint funding of grants, matching of university people to projects sites in zoos and aquariums, coordination of long-term research projects, and the publication of a national newsletter. Other points follow on the reverse side.

The following points were made in the general discussion of the need for this Consortium and its functions:

1. A network is needed to link educators and researchers at zoos, aquariums and universities.
2. Successful consortia in the C.S.U.C. system have a lot of capital involved; this Consortium needs a facility to establish its permanence.
3. Joint financial commitment of the zoos and universities is needed.
4. This Consortium network can help the university recognize how valuable a resource they have in the modern zoo and aquarium.
5. Zoos and aquariums can help the university in its maintenance of live animals.
6. The Consortium can help faculty who wish to do research at the zoo by providing training in observational techniques.
7. Since much of the valuable work done at zoos and aquariums does not reach print, collaboration with university people can increase the probability of its publication.
8. Since zoos and aquariums are oblized to work with university students as part of its educational commitment the Consortium can help their professors provide better supervision and guidance with their projects.
9. The university can develop and coordinate extension courses involving zoos and aquariums for teacher education students as well as for science teachers.
10. The special high ability high school students could be involved with the zoos and aquariums in the grant-funded summer programs.

The following points were made in the general discussion of the formation and structure of the organization:

1. Options in forming the organization include having the S. California Academy of Sciences or the Animal Behavior Society take it over.
2. The organization could begin informally as a conference, then later create a Consortium; the organization could be formed as an institute, which has a singular purpose ; since a consortium is more loosely arranged than most other organizations, this form is the most appropriate for our purposes.
3. Voluntary participation in our organization is important.
4. The main function of our Consortium is creating a wide network for sharing of of information - using electronic bulletin boards and a newsletter. The Consortium headquarters at the hosting institution can act as the information clearing house.
5. The Consortium can provide a procedural format for interns at zoos and aquariums, provide guidelines for professors as well as students for doing research at zoos and aquariums, coordinate long-term series of individual students to work on single projects, provide skills-seminars to students and professors, etc.
6. Zoos can provide lists of projects of importance to them, including studies of visitor behavior and exhibit evaluation.
7. Consoritum can provide a "skills bank" as well as a pool of resources.
8. A standardized data base can be provided by the Consortium for pooling of animal resources. [The ISIS database of AAZPA already exists.]
9. The Consoritum can link the university, zoo and aquarium researchers and educators with natural history museums, which have a long history of welcoming university researchers.
10. Zoo and aquarium educators can work with university educators in developing better teacher workshops as well as improving zoo education programs.

University, Zoo, Aquarium and Natural History Museum people who are interested in this organization and in its national newsletter are requested to write.

ASSOCIATION OF ZOOLOGICAL HORTICULTURE - NARRATIVE

R. H. Hider

National Zoo

The design, use and maintenance of plant material in and around animal exhibits is an extremely sensitive discipline. The landscapes in zoos and aquariums require all the aesthetical and functional principals of design and all the cultural needs of sound horticultural management to maintain plant species in good health, but there is also the added dimension of the unpredictable destruction and/or reaction of animals to the vegetation. This, coupled with an upswell of exhibition philosophy which demands more and more use of plants in animal enclosures, has produced an urgent need for specialists skilled or trained in the unique field of zoological horticulture. Because of the lack of reference resources and educational programs geared to growing plants with animals, personal experience from veteran zoo horticulturists is the only opportunity for learning in this highly specialized profession.

In August 1980, a group of zoo horticulturists from around the world met with the idea of forming an association. This organization would promote zoo horticulture and provide a forum for the sharing of ideas. In October 1982, a second conference was held with fifty participants. It was at this gathering that the existing Bylaws were adopted and the first officers were elected. The association has since had three additional meetings and plans to continue to have annual meetings hosted by different zoos or aquariums geographically rotating around the country.

In addition to organizing an annual conference, other activities will relate to: conservation efforts for endangered and threatened plant species; publication and distribution of the association newsletter, conference proceedings, research papers or other related printed materials; supporting organizations in developing and staffing zoological horticulture programs; and fostering an awareness by the public for the importance of plants in the continuation of life on earth.

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AUDIO-VISUAL RESOURCES IN PRIMATOLOGY: THE COLLECTION OF THE LIBRARY OF THE WISCONSIN REGIONAL PRIMATE RESEARCH CENTER

Larry Jacobsen, Linda Endlich, Ray Hamel, Wisconsin Regional
Primate Research Center, University of Wisconsin, Madison, WI
53715-1299

The library of the Wisconsin Regional Primate Research Center at the University of Wisconsin-Madison is developing an audio-visual collection which focuses on nonhuman primates. The collection includes slides, audiotapes, videotapes and a limited number of films. Materials are available for loan and are intended to support both educational and research activities. The long-range goal is to develop an in-depth resource which will help to preserve the visual and vocal record of endangered and threatened nonhuman primates and to make Center resources broadly available to those who need access to these often difficult-to-locate materials.

The collection is intended to cover all extant genera and species in a range of audio-visual formats. Our current slide holdings, for example, consist of over 1250 slides representing 125 species. Current slide collection emphases are: (1) pelage or other taxonomic features, (2) sexual dimorphism, (3) social and/or family groupings, (4) specific behaviors, e.g., sex, play, feeding, aggression, parenting, (5) facial expression, (6) habitat, (7) food preferences, and (8) aging-related changes. Slide sets are available on the mountain gorilla, the chimpanzees of the Arnhem Zoo, and Brazilian primates--just to name a few examples. In addition to slides of nonhuman primates, related collections will include slides of eminent primatologists, NIH primate centers in the Primate Centers Program, and other special subjects as need warrants. A collection of primate vocalizations is also available. Films, videotapes, and cassettes will be included as funding allows.

While a few items require on-site use, most materials, including slide sets, audiotapes and videotapes, are available for loan. Loan copies of audio-visual materials are supplied to anyone wishing to use them for appropriate scientific or educational purposes. To alert users to newly acquired items, the library publishes the _Primate Library Report: Audio-visual Acquisitions_. This publication is sent out to current members of the American Primatological Society and to others on request.

Materials donated to the collection bear both the name of the photographer or producer and the warning, "Do not duplicate." Copyright of donated materials remains with the originator. The collection is for loan purposes only and copies for publication are not provided. Inquiries related to publication of loaned materials are directed to the contributor for approval. Contributions are tax deductible.

An IBM-PC with KnowledgeMan software is being used to catalog and access the collection. All slides, for example, are assigned a unique number; tagged for genus, species, common name, age, sex, format of visual image; and given concept codes. Concept codes are subject headings assigned to all items from a predefined glossary. This program allows for both specific and broad retrieval. It is possible, for example, to query the program for slides of gorilla feeding behavior in captivity or, more broadly, for portrait slides of New World primates. All audio-visual materials, regardless of medium, can be searched using this program. Information provided by contributors to the collection are used to key in the material.

The quality of the collection depends on the support of the primatological community--both those making a visual record of their research and those who record vocalizations. Offers to contribute materials have been generous and continue to be greatly welcomed. Contributors have the satisfaction of knowing that their work will be carefully preserved in a centralized depository and that it is available for scientific and educational uses. Placing materials in the collection not only makes them widely available, but mitigates against their loss by accidental destruction.

Inquiries about borrowing from or contributing to the collection should be be addressed to the authors.

A NATURAL DISPLAY OF WOLVES AND AMERICAN BISON IN A WILDLIFE PARK.

By Erich Klinghammer, Ph.D., Director
WOLF PARK, Battle Ground, Indiana 47920
(317) 576-2265

At WOLF PARK we feature a realistic and aesthetically pleasing exhibit of GREY WOLVES (Canis lupus) and AMERICAN BISON (Bison bison). The two species live in separate enclosures except during the wolf-bison interactions which are carried out for behavior research purposes each Sunday in full view of the visiting public.

Our exhibit shows wolves and bison interacting in ways that are almost identical to what can be seen in the wild. The only difference is that we control the situation to the extent that no member of either species is injured or killed. The occasional contacts of wolves and bison have been inconsequential and required no medical care. If there is a sick bison it is removed from the herd prior to the introduction of the wolves.

THE HANDLING OF THE BISON:

A small herd, which currently consists of 17 American bison, is maintained in a 17 acre enclosure fenced in by a four foot high cattle fence topped by a strand of barbed wire, with another strand inside the fence about 18 inches below and parallel to the top wire. Scratching posts, large rocks, dust and mud wallows allow proper bodily care and thus prevent the destruction of fences that could occur in the absence of these features.

There are two adult bulls, five adult cows, and seven subadult bulls and cows, between the ages of one and three years, as well as three calves which were born in the spring of 1985. The bison are parent-raised, but their flight distance to humans is short, from 0 to 2 - 3 meters.

To avoid aggressive encounters with humans the bison are not herded. Instead they have been trained to follow our personnel, or a VW bus. In this way they can be moved from one pasture to the next, or to an area favorable for viewing by the public. This is accomplished by rewarding the bison with apples or with hay when the pasture is poor.

HANDLING OF THE WOLVES:

All of our wolves are handraised from less than two weeks of age. At four months of age they are returned into the Big Pack which currently has 12 members. The wolves are trained to walk on a leash and are led to the bison enclosure by experienced volunteers under the supervision of permanent staff personnel. When the interaction ends about 45 minutes later, the handlers howl and rally. These auditory and visual stimuli bring the wolves in at a run to greet the humans, who can then easily chain them up again, walk them out of the enclosure, and return them to their pack.

A TYPICAL WOLF - BISON INTERACTION:

Usually one or more of up to six wolves will trot up to the bison herd, often after exploring the enclosure, hunting mice, scent-rolling, or drinking water and such. -- Appearances to the contrary, the wolves observe the bison closely, and they immediately respond to anything unusual in a bison's appearance or behavior by closing in. -- A bison away from the herd, or a calf more than two to three body lengths from an adult is immediately approached. -- One or more wolves usually assume a bowing posture as they close in on a bison. This allows the wolves to be ready to either escape a bison's charge or follow up with a charge of their own. -- The usual approach is towards the flank of a bison, while another wolf may be trying to elicit a charge by approaching a bison from the front.

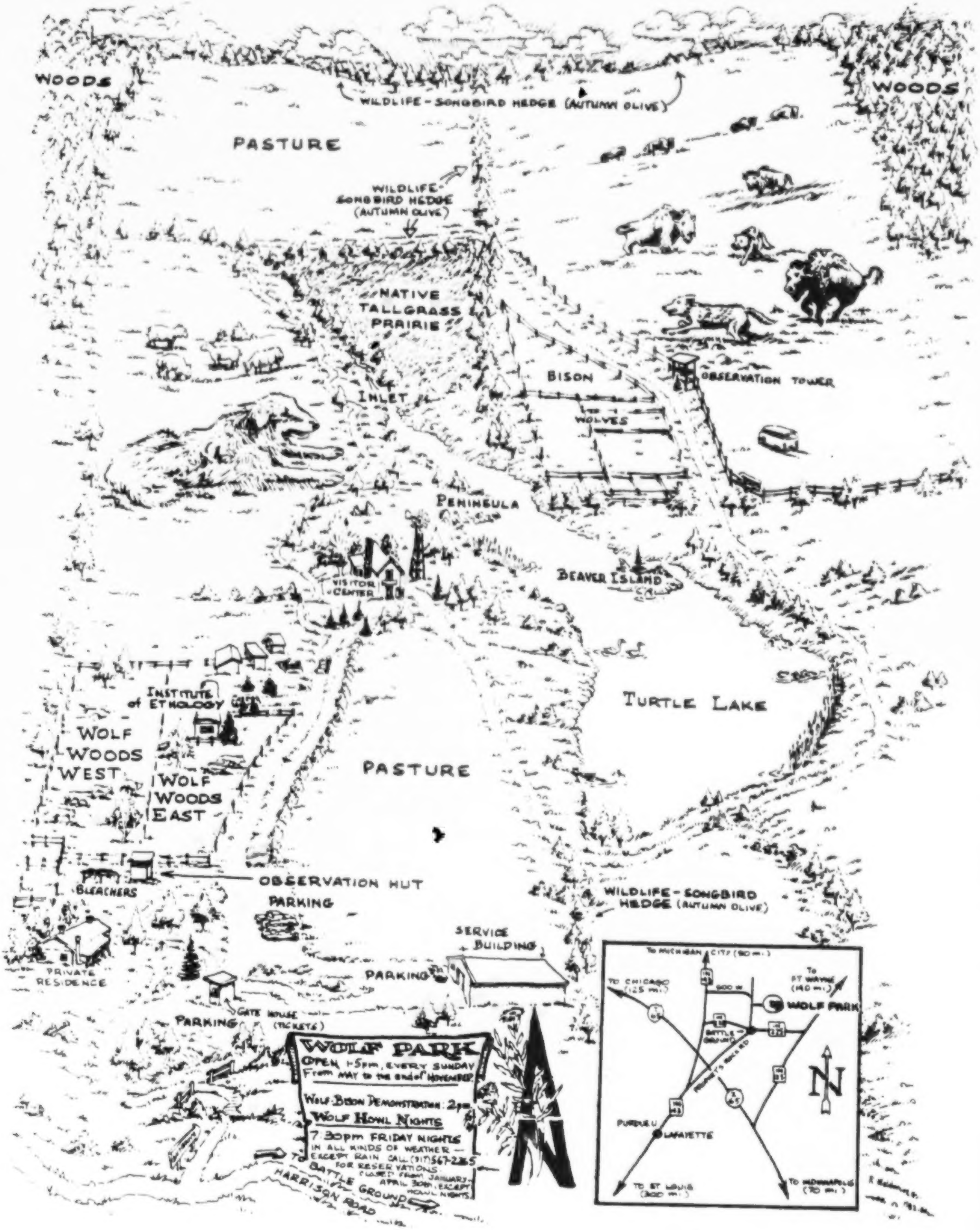
Contrary to expectations, the wolves do not really cooperate or follow a specific strategy in testing bison. However, as soon as one wolf perceives an opening it will immediately close in on the bison. It is this visual cue that attracts the the other wolves to join in the attack. -- A bison in distress, especially a calf that is grabbed and emits a distress call, at once brings the subadult bulls, cows and yearlings on the run. The wolves scatter, and are sometimes kicked or tossed with a thrust of the head. The older bulls and cows, unless one of the latter is defending her calf, are not as active in attacking wolves. -- In the event that a bison is pressed too hard, the wolves can be approached and distracted, called, chained and led away. This is possible because hunting wolves are very cautious and are easily interrupted, unlike fighting wolves which are difficult or impossible to stop. -- The bison discriminate between upright humans and four-footed wolves, and attack only the latter. -- Actual body contact between wolves and bison is extremely rare. No wolves have been injured, and other than a scratch on the nose or ear,no bison have been injured in the three years that we have done this research.

SUMMARY: THROUGH THE APPLICATION OF ETHOLOGICAL ANALYSIS AND APPROPRIATE TRAINING, WOLVES AND BISON CAN BE DISPLAYED TOGETHER IN A SEMI-NATURAL SETTING. WITH PROPER ATTENTION TO THE ANIMAL'S AND HUMAN'S BEHAVIOR THERE IS LITTLE DANGER TO ANYONE. THE PUBLIC'S RESPONSE TO THIS EXHIBIT HAS BEEN VERY POSITIVE, AND NO ADVERSE COMMENTS HAVE COME TO OUR ATTENTION. - HOWEVER, SOME VISITORS HAVE VOICED DISAPPOINTMENT THAT NO BISON WERE BEING KILLED. - OUR AIM IS, OF COURSE, TO STUDY THE HUNTING STRATEGY OF WOLVES AND THE DEFENSIVE BEHAVIOR OF THE BISON, AND NOT TO CREATE A SPECTACLE.

- The wolves wander through the herd in search of bison that may show signs of weakness. Our healthy bison are quite relaxed.

- "Tecumseh" - a two year old bull - decides to chase the wolves who nimbly dodge his charge.

- After testing the bison, researcher's howls assemble the wolves to leash them to be returned to their enclosure. - Photos: Erich Klinghammer, 1983.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WILDLIFE-SONGBIRD HEDGE (AUTUMN OLIVE)
WOODS
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WILDLIFE-SONGBIRD HEDGE (AUTUMN OLIVE)
NATIVE TALLGRASS PRAIRIE
BISON
OBSERVATION TOWER
INLET
WOLVES
PENINSULA
VISITOR CENTER
BEAVER ISLAND
INSTITUTE of ETHOLOGY
WOLF WOODS WEST
WOLF WOODS EAST
TURTLE LAKE
PASTURE
OBSERVATION HUT
BLEACHERS
PARKING
WILDLIFE-SONGBIRD HEDGE (AUTUMN OLIVE)
SERVICE BUILDING
PRIVATE RESIDENCE
PARKING
PARKING
GATE HOUSE (TICKETS)
WOLF PARK
OPEN 1-5pm, EVERY SUNDAY From MAY to the end of NOVEMBER
WOLF-BISON DEMONSTRATION: 2pm
WOLF HOWL NIGHTS
7:30pm FRIDAY NIGHTS IN ALL KINDS OF WEATHER — EXCEPT RAIN CALL (317) 567-2265 FOR RESERVATIONS
CLOSED FROM JANUARY-APRIL 30th, EXCEPT HOWL NIGHTS
TO BATTLE GROUND
HARRISON ROAD
TO MICHIGAN CITY (90 mi.)
TO CHICAGO (125 mi.)
TO FT WAYNE (140 mi.)
WOLF PARK
BATTLE GROUND
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TO ST LOUIS (300 mi.)
TO INDIANAPOLIS (70 mi.)
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SOME GENETIC CONSIDERATIONS FOR THE MANAGEMENT OF CAPTIVE POPULATIONS SUGGESTED BY COMPUTER SIMULATIONS

Robert Lacy
Chicago Zoological Society
Brookfield, Illinois

Genetic changes occur in small populations because each generation contains only a limited sample of the genes of the previous generation (random "genetic drift"). Thus, a small captive population will drift away from the genetic constitution of the founding stock, and genetic variability, necessary for the long-term adaptability and viability of the population, will be depleted as genetic variants are lost from the population.

Large populations lose genetic variability by random drift much more slowly than do small populations. Because zoos have finite resources, however, the number of species that can be preserved and propagated in zoos is inversely related to the numbers of animals kept for each species. Thus, while maintaining too few breeding animals will result in random genetic changes and a loss of diversity that may cause the eventual demise of the captive population, keeping too many of any species necessarily limits the number of species that can be maintained.

How many animals need to be maintained in a breeding population to keep genetic drift at an acceptably low level? This question has received a lot of attention recently (e.g., Franklin, 1980; Foose, 1983), and the number depends on how one chooses to define the "acceptable" loss of variability and how one considers the costs (in terms of species conservation and otherwise) of maintaining large breeding populations.

How should the population be structured to make best use of the animals in captive breeding programs? The numbers of animals needed in a breeding population will depend also on how those animals are used: whether they are partitioned into subpopulations, whether immigration into and out of populations is allowed, and the extent to which selection (both artificial and natural) is occurring.

To study the loss of genetic variability in captive populations, and to suggest effective management strategies to minimize the loss, a computer program was written to simulate the genetic changes that would take place in small populations. The computer program:

1) Establishes the population in its memory and assigns genes to each animal. The population can be divided into subpopulations, if desired.
2) Selects parents (randomly, or as specified) to produce the next generation.
3) Produces progeny, assigning genes according to Mendelian genetic principles.
4) Allows genes to mutate, if specified.

5) Allows immigration into the population from a large (infinite) base population from which the founders were initially drawn.
6) Allows migration between any subpopulations, with the specified number of migrants being chosen at random.
7) Allows natural selection (i.e., differential survival rates of genetic types).
8) Monitors the genetic changes that occur over 100 generations.

RESULTS:

Random fluctuations in gene frequencies result in a loss of genetic variability, which is most easily expressed as a change in the heterozygosity of the population. It is well known that small populations lose genetic variability much more rapidly than do large populations, but rarely appreciated is the extremely erratic and unpredictable nature of the random changes that occur at any given gene. Repeated simulations of the variability lost by random drift from a population of 100 breeding animals produced cases in which all heterozygosity was lost within 70 generations from genes that initially had two equally frequent variants and cases in which 99% of the variability was still present after 100 generations. Typically, populations of 100 breeders lose about 60% of their heterozygosity in 100 generations of random change.

POPULATION SUBDIVISION affects genetic variation in complex ways. In a subdivided population (resulting from, perhaps, a partitioning of the captive breeding population into regional management units) genetic variation can be maintained either within each subpopulation (expressed as heterozygosity of individuals) or between the subpopulations (expressed as genetic differences between subpopulations). With no exchange of animals between 10 subpopulations of 10 animals each, the subdivision of a simulated population resulted in a more rapid loss of variation within each subpopulation than would be observed in a single, randomly mating population of 100 breeders. The different subpopulations lost different genetic variants, however, and the total genetic diversity of the population was maintained permanently at almost initial levels.

PARTIAL SUBDIVISION, with the movement of one animal per generation between subpopulations (one animal from one of the subpopulations, not one animal from each subpopulation), resulted in a loss of within-subpopulation variability that was less rapid than under absolute subdivision, but still faster than without any subdivision. Total variability was not maintained as well as with absolute subdivision, but was still kept at very high levels.

WEAKLY SUBDIVIDED populations, with five inter-subpopulation migrants per generation, maintained both within-subpopulation variability and overall variability at levels comparable to non-divided populations. Thus, moderate amounts of migration between subpopulations cancel the genetic effects of a subdivided population structure.

STRATEGIES OF SUBDIVISION

If individual heterozygosity (within-subpopulation variation) is important to the vigor of animals in a captive-breeding population (as it would likely be for a species that normally outbreeds in the wild), the captive population should not be subdivided. If it must be subdivided for managerial reasons, the movement of several animals per generation across subdivision boundaries should be used to cancel the genetic effects of the subdivision. If individual heterozygosity is not as critical as is the long-term maintenance of genetic variation within the overall captive population, subdivision should be considered and between-subpopulation migration should be kept to less than one migrant per generation.

Fortunately, the effects of population division on variation within subpopulations can be readily reversed by combining former subpopulations. After mixing the subpopulations, the total genetic variation formerly present within and between subpopulations would be returned to within-population heterozygosity. In most cases, the restored large population would contain even more variability than it would have contained if it had never been subdivided. Thus, a decision to subdivide a captive population can be effectively reversed if data indicate that the loss of genetic variation within each subpopulation leads to unacceptable declines in the vigor of future generations.

Genetic variation lost by genetic drift can be restored by mutation and by immigration from other, more variable or genetically different, populations. IMMIGRATION from large outside populations is very effective at restoring genetic variation that has been lost by genetic drift. With just one immigrant arriving each generation, populations maintained most of their initial variability indefinitely. If a large population of a species still exists in the wild, introduction of just one newly caught animal into the captive population each generation is sufficient to counter the genetic changes that would otherwise occur by genetic drift.

MUTATION at a rate of 10^{-2}/gene/generation restored genetic variation a rate comparable to the rate of loss by random drift from simulated populations of size 100. Such high rates of mutation have never been observed in any population, however, and that high a rate of mutation would certainly kill all individuals of the population. Mutation at a rate of 10^{-4}/gene/generation restored very little of the variation lost from small populations, but even that level is unrealistically high. Mutation more typical of that observed in populations (10^{-6}/gene/generation) had no effect on the amount of genetic variability maintained in populations of sizes that could be kept in captivity. In fact, it is unlikely that any new mutants of a specified gene would appear in a population of 100 animals observed over 100 generations.

CONCLUSIONS:

1) The effects of proposed management plans on the genetic variability of captive populations can be quickly simulated by a computer program.

2) In populations of less than about 500 breeding animals, the cumulative effects of random drift can noticeably change the genetic make-up of a population over the course of 100 generations, leading to a loss of the genetic variability that is important to the long-term persistence of the population. The loss of variation can be substantial if population sizes are less than 100.

3) Population subdivision can be an effective and flexible management tool. At a cost of some within-subpopulation (individual) genetic variability, the total variability of a captive population can be kept very near its initial level by dividing the population into smaller management units that will diverge genetically from each other. Individual heterozygosity can be restored later by recombining the subpopulations, returning the overall population to a genetic condition little different from that of the initial founder stock.

4) Occasional introduction of newly caught individuals into a captive population will virtually halt the loss of genetic variability. Reciprocally, occasional re-release of animals from a large captive population into a very small natural population can prevent the loss of genetic variation from the wild population that might otherwise lead to its extinction.

5) Mutation occurs too infrequently to replace any measureable amount of the genetic variation lost by drift from captive populations.

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Asian Wild Horses at the Topeka Zoo

by Mike LaRue, Craig Dinsmore and Ron Kaufman

Exhibition, Propagation, Research

The Topeka Zoo maintains Asian wild horses in two separate areas. One or two horses are exhibited at the Zoo. They are surplus or bachelor animals and represent the species for the public. The other area is ten miles from the Zoo, on a remote section of land leased from the Metropolitan Topeka Airport Authority. There, groups of the horses are managed for breeding and study. It's the Zoo's Conservation/Propagation Center.

The Zoo has kept the Asian wild horse since 1971, when a stallion named "Rolf" arrived on loan from the Brookfield Zoo. Other specimens began arriving five years later. The first foal was born in May, 1978. A year later, the breeding nucleus was moved off-site to the Conservation/Propagation Center. Twelve foals have been born into the Zoo's collection, of which 11 survived.

The off-site facility is especially conducive to behavioral studies, as well as breeding. The grassy two-acre pastures provide ample room for herd dynamics. Lee Boyd has studied the group for several years. She is presenting a paper at this Conference

The Conservation/Propagation Center at Forbes Field

The site formerly served as a munitions storage area for the Air Force. The USAF pulled out in the late 1960s and the land was deeded to the Metropolitan Topeka Airport Authority. The MTAA leases the site to the Friends of the Zoo.

"CPC" consists of 55 acres of pasture surrounded by a ten-foot fence. Four earth-covered concrete bunkers stand on the site. The pasture around the bunkers is divided into two-acre yards that can be connected to form larger yards. A large storage barn and several smaller buildings dot the remaining acres. Outside the fenced area is a giraffe-holding building of 1600 sq. feet with an attached exercise yard.

The Herd

1971...Arrival of "Rolf", a 20 year old stallion from the Brookfield Zoo. Although it was later discovered that he had been neutered in Europe years earlier, he becomes the "symbolic founder" of the Zoo's future commitment to the Asian wild horse.

1977..."Rolmar" from Catskill and "Colleen" from the Brookfield Zoo become the first viable breeding pair at the Zoo.

1978..."Rococo" is the first foal born at the Zoo.

1979..."Rolmar" and "Colleen" are moved to the Conservation/Propagation Center.

1985..."Marco", a colt born at Topeka in 1980, is sent from the San Diego Zoo to the Peking Zoo, Peoples Republic of China to introduce a new bloodline.

"Lory", a filly born at Topeka in 1982, has her first foal at Lelystad, The Netherlands.

"Rolmar", the herd stallion at Topeka, is retired after having sired 11 surviving foals in a seven year period.

Included in the poster presentation is a number of photographs of Asian wild horses at the Topeka Zoo's Conservation/Propagation Center. Also included is a chart depicting the breeding combinations of the stallions and mares at the Zoo and the eleven offspring produced, with a short description of the location of some of the offspring. For more information contact the lead author at the Topeka Zoo, 635 Gage Blvd., Topeka, Ks. 66606. (913) 272-5821

HEMOLYTIC ANEMIA IN THE BLACK RHINOCEROS
(*Diceros bicornis*)

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The death of a 9-year-old female black rhinoceros (*Diceros bicornis*) at the St. Louis Zoo in May 1981 led to an interest in the frequency of this problem in other members of this species. In response to a questionnaire and inquiries to zoos worldwide, 28 episodes of hemolytic anemia in 21 individual animals have been located. The anemia was fatal in the initial or in a recurrent episode in 80% of the animals. The anemia accounted for 40% of the adult black rhinoceros deaths located in the survey. Though family groupings were noted at St. Louis, Denver and Frankfurt zoos, no definitive familial, sex, age or seasonal pattern to the disease could be determined. The cause of the acute hemolytic crises, where hematocrits may drop from a normal of 45% to 5-10%, remains unknown. Leptospirosis appears likely in several cases; however, it could not be diagnosed in others despite intensive efforts. No one best treatment regimen has been determined, but the animals treated with corticosteroids in addition to antibiotics appear to live longer. Research efforts have centered on possible infectious, toxic, autoimmune or inherent red blood cell defects as possible causes. This research is presently ongoing, and specific evaluations for red blood cell enzymes and autoimmune testing are available at UCLA and Washington University, St. Louis. Blood samples from any future cases of hemolysis in this species are requested in an effort to identify the cause of this devastating syndrome in the black rhinoceros.

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TITLE: FLEXIBLE FIBEROPTICS

A New Tool for Zoo Use

St. Louis Zoological Park
Douglas S. Pernikoff, DVM
Resident Veterinarian

Introduction

The exciting, innovative concept of a flexible fiberoptic scope has recently come of age. To date, most of us recognize and associate "FIBEROPTICS" with the rigic laparoscope, the instrument used to surgically sex birds. The same physical principles are employed in the use of the newer, flexible fiberoptic scopes. Light is projected to and from the particular body region being investigated along glass rod structures. The added qualities of flexibility and durability greatly expand the clinical applications of this instrument. The versatile scope can enter any natural or surgically created orifice; turn 180° in any direction and permit gross visualization of body regions heretofore not readily accessible. The employment of specialized biopsy tools and cytology brushes fitted along parallel channels to the glass rods, provide avenues for extensive diagnostic and therapeutic applications.

Advantages:

[1] Clear, precise visualization of relatively inaccessible body regions

[2] Minimal or NO surgical intervention implies a SAFER, QUICKER procedure

[3] Multiplicity of function and versatility of applications incorporated into a single base instrument

[4] Portability-lightweight, compact design

[5] Technically simple to master

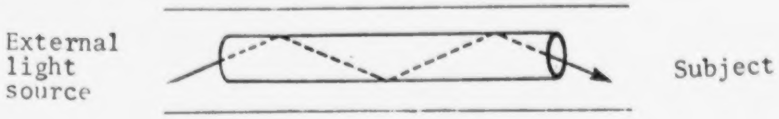
Disadvantages:

[1] COST$ of the initial equipment acquisition

PHYSICAL PRINCIPLES:

A. Transmission of Light

Very simply stated, an external light source presents light to a glass fiber. The light is trapped and conducted downwards along the glass fiber by numerous reflections from inner wall to inner wall. This phenomenom is described as 'TOTAL INTERNAL REFLECTION'. A bundle of these glass fibers fitted in random association is called an 'INCOHERENT' bundle.



TOTAL INTERNAL REFLECTION
[--single glass fiber--]

B. Image Production

A fiber bundle arranged so that individual glass fibers are in the same position at both the proximal and distal ends of the cable is called a 'COHERENT' bundle. Lenses at the distal (subject) end pick up the image and light, directing both to the viewing end along a parallel, 'COHERENT' bundle. At this proximal (viewing) end, another series of lenses in sequence serve to magnify and focus the image. Acuity and resolution of the image is based on the size and spacing of the fibers within the coherent bundle as well as the quality and sequencing of the objective lenses.

GENERAL FEATURES: [Product Averages]

Fiberscope (cable) lengths	70-120 cm.
Viewing angles	60-85°
Tip diameter	9.0-13.5 mm.
Tip deflection	*180-200°

*Some products limit deflection in varying positions.

TERMINOLOGY:

The 'generic' flexible fiberoptic instrument is best defined simply an an 'ENDOSCOPE', an instrument permitting visualization inside.

The jargon applied to this science is at first foreboding to any lay person. Upon closer examination it becomes apparent that these terms are simply a compilation of prefixes that define the body area under examination. For example,

COLONoscopy- visualization and study of the colon(large intestine)

VAGINoscopy- examination of the vaginal canal

TRACHEoscopy- examination of the trachea (upper airway)

Note that the same instrument performs any or all of these studies; relative to instrument size and corresponding orifice diameter.

APPLICATIONS:

The clinical applications of the flexible endoscope are nearly endless. There is the potential to explore any natural or surgical orifice as the need calls for. The instrument can reach anatomical regions that in the recent past, were inaccessible without surgical exploration. Accessory tools designed to work through the flexible cable allow limitless diagnostic and therapeutic uses. The opportunity for research applications is also open for creative thinking.

CAPTION 1:

Examination of the upper(rhinoscopy) and lower(bronchoscopy) respiratory tract is a commonly employed technique in equine and small animal medicine. A similar approach is used here to examine the bronchi of this asian elephant.

CAPTION 2:

In this case an adult female siamang ape, ill with a chronic, intermittent diarrhea, was scoped both orally and rectally. Visualization and physical retrieval of stomach worms(Physaloptera spp.) has offered a possible diagnosis and suggested course of treatment. Repeated fecal exams had been negative for the presence of the worm ova.

CAPTION 3:

The understanding of elephant reproductive mechanisms is still in its infancy. The flexible panendoscope is applied here to examine the vaginal canal in hopes of visualizing the animals cervix. If successful, we advance one step closer towards the goal of artificially inseminating these grandiose creatures.

COTTON-TOP TAMARINS: THEIR ROLE IN CAPTIVE PROPAGATION AND RESEARCH

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Within the last two decades, the population of cotton-top tamarins (Saguinus oedipus oedipus) living in their native South America has declined dramatically. Due to the extensive destruction of its tropical rainforest habitat in Northern Columbia and its use in biomedical research the cotton-top tamarin was declared an endangered species in 1973. Subsequently, efforts were made to breed these monkeys in captivity. Many colonies have reported very low survival rates of captive born infants with most of the mortality occurring in early infancy. However, with the development of new breeding techniques the survival of this species in captivity is promising. We emphasize the experiences of our colony at the University of Wisconsin (Snowdon et al., in press), one of the few which has had considerable success with infants born to first and second generation captive born females. Our success is attributed to a variety of factors.

Our animals are housed in large complex environments as either newly established breeding pairs or in family groups with offspring remaining in the group for at least two subsequent litters. The cages are constructed of wooden frames and stainless steel hardware cloth. They range in size from a minimum of .85 mW x 1.5 mL x 2.3 mH to a maximum of 1.8 mW x 3.0 mL x 2.3 mH. A complex system of branches, ropes, and wooden runways is constructed in each cage. Since tamarins are reluctant to approach the floor of the cage, the food dishes, water bottles and the majority of the runway systems, are in the upper half of the cage, above 1 m. Runways are changed often to provide continuous environmental stimulation for the tamarins. As marmosets and tamarins are the only clawed monkeys, wood and fiber supports are critical for their locomotion and are preferred over stainless steel and other non-fibrous materials. In our colony, we avoid capturing and stressing the animals whenever possible. Most minor illnesses are detected early and can be treated by medications administered through special feedings, and some individuals can be treated for minor cuts and abrasions by direct administration of topical medication.

Like many primates, cotton-top tamarins must learn the parental skills needed to successfully rear offspring. Both male and female cotton-top tamarins learn parental care through a complex interaction of observing and participating in carrying and playing with infants in a family group (Cleveland & Snowdon, 1984). In this species, the father and older siblings carry the infants most frequently. In general, the infants are carried by their mother only when they are nursed. Those males and females who have not had early infant caretaking experience during their developmental years have a lower success rate for rearing infants than those who have had such experience. Regardless of early experience with infants, females are likely to reject their first litter, although they usually raise subsequent litters.

In our colony only infants that are being abused or neglected are removed from their family group for hand-rearing. Our hand-rearing regime was designed to maximize survival rate of the infants through the use of heated mobile surrogates, a non-human primate infant formula (Primilac), and special nipples (Dronzek et al., in press). However, to ensure the normal social development and to gain the infant caretaking skills needed to be a skilled parent, all hand-reared infants were systematically reintroduced to a family group. Our technique has been quite successful to date. We are pleased to report that a second generation hand-reared female on loan to the Milwaukee County Zoo has given birth to twins and is successfully rearing her offspring.

Since the cotton-top tamarin is a valuable animal to study we have devised techniques to gather research data from the animals with the minimal amount of disruption to the colony. Some of the techniques require the tamarins to actively participate in the research. For example, we can assess the cognitive abilities of these animals through a complex series of discrimination tasks (Savage et al., in preparation). Unlike the procedure of most learning tasks, the test apparatus is portable and can be placed next to the animals' home cage. The animals are required to displace objects for food rewards. Their performance is much higher than those who were food deprived or tested in an isolated testing cage. Moreover, the animals worked for longer periods when they were tested in this manner.

Daily hormonal samples are gathered using a simple conditioning technique. Urine collection is a relatively simple procedure in which females allow their urine to be collected into containers in return for a food reward. Through the use of urinary assays we can determine the levels of gonadal steroids and gonadotrophins during ovulation and pregnancy (Ziegler, in press). Hormonal data can even be gathered on the day of partuition without risk to mothers or infants.

By using simple observational techniques we have clearly documented the complex vocal repertoire of this species (Cleveland and Snowdon, 1982). We have also examined the ability of the tamarins to perceive subtle differences in the structure of their call through playback experiments utilizing speakers placed in each cage.

As an endangered species it is not sufficient merely to propagate cotton-top tamarins but to learn as much as possible about them. By studying them in captivity we can improve our knowledge of how to successfully breed these animals and gain valuable scientific information that may not be available from other species. By producing valuable research results one can also create an economic justification for species preservation.

Much of the research discussed here has practical applications to the continued survival of the species in captivity. Through a variety of observational and non-invasive data collection techniques we have been able not only to increase our breeding success, but to make a significant contribution to a variety of important research areas. By adapting our methods of data collection to the animals rather than adapting animals to traditional experimental techniques, we can ensure minimal disruption to the animals, produce valuable reliable data, and contribute to the development of more humane techniques for use on other animals.

It has been our experience that our monkeys do quite well in zoo environments if proper attention is given to the design of their exhibit. Caging in a quiet area is most appropriate for this species and the exhibit should have plenty of foliage or other materials that afford opportunities for cover. The Milwaukee County Zoo's Tropical River exhibit is an excellent example of an ideal habitat for these animals. The tamarins not only have a spacious and lush exhibit, but are also housed with a variety of finches and fishes in a semi-natural environment.

For the public the tamarins are quite interesting. They are one of the few monogamous primates, they generally give birth to twins, all family members are active in infant care, and they have a rich vocal repertoire. As a little known endangered species, it also provides good opportunities for public education about conservation issues and the need for captive propagation.

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COMPARISON OF EXTENDERS WITH GLYCEROL IN CRYOPRESERVATION OF SEMEN FROM EXOTIC AND DOMESTIC FELIDAE

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Of the 37 species of exotic felidae, approximately one-third are endangered or threatened, while many others are considered critically rare. Current trends of habitat destruction and human encroachment upon these animals in the wild may eventually eliminate existing populations. Inbreeding among remaining captive populations poses an increasing threat to the viability of future generations. The acquisition and transportation of adult animals for breeding purposes is not only cost prohibitive, but often risky and stressful. To help counteract these deleterious effects, current genetic material is being collected for long term storage via cryopreservation. The storage and transportation of genetic material such as sperm in small straws or pellets may reduce these factors for rare and valuable animals in the future.

The Cincinnati Wildlife Research Federation was formed in 1981 as a group effort between the Cincinnati Zoo, Kings Island Wild Animal Habitat and the University of Cincinnati College of Medicine, Department of Obstetrics and Gynecology. This Federation has undertaken a long term comparative study of the semen from exotic felidae. The specific objectives of this project are to: 1) determine if collection of viable semen by electroejaculation is possible in select individuals of certain species, 2) contribute to a growing data bank of information on volume, concentration and morphological aspects of semen from exotic felidae, 3) investigate the use of a wide range of buffering solutions as diluents to prolong the life and viability of felid spermatozoa, 4) compare the liveability of sperm frozen in varying levels of cryoprotectant (glycerol), 5) aid in determination of optimum rates of cooling, freezing, and thawing of extended felid semen.

Semen was obtained by electroejaculation from the domestic cat (Felis catus) and the following exotic species: Jungle cat (Felis chaus prateri), Persian leopard (Panthera pardus saxicolor) and cheetah (Acinonyx jubatas). All animals were anesthetized with Vetalar (ketamine hydrochloride, Parke-Davis) sometimes supplemented with Valium (diazepam, Roche). Rhythmic electrical impulses were delivered via a lubricated rectal probe to stimulate accessory sex organs, resulting in ejaculation. Probe size and degree of stimulation were determined by animal size. The penis was manually everted and the urethral orifice covered by a collecting tube contained inside a vessel filled with 30-35°C water to lessen temperature fluctuation during the procedure, which could cause physical damage to the spermatozoa. Tubes were frequently changed during the procedure to facilitate collection of sperm-rich fractions.

Samples were evaluted for volume, percent motile cells and percentage rates of forward progression, then slowly diluted to a ratio of 1:1 with extender at the same temperature. Extended samples were then mixed and refrigerated in the waterbath jacket to ensure gradual cooling to 10°C. After ten minutes, a second portion of cooled extender equal in volume to the first was slowly added to the refrigerated sample, which then equilibrated an additional 20 to 50 minutes before freezing.

Extenders were composed of 20% egg yolk (v/v), glycerol of 2, 4, 6, or 8% (v/v), and one of the following buffering solutions: 11% lactose (w/v) (Platz et al, 1978), 2.9% sodium citrate (w/v) (Marshall, 1984), Tyrode's salt solution, Earle's salt solution, or TES-Tris (TEST). Penicillin-G (sodium salt), and streptomycin sulfate were added to all extenders at a rate of 100,000 i.u. of each per 100 ml of buffer (Platz et al, 1978).

Semen was frozen by two methods. Samples were aspirated into 1/4 or 1/2 ml straws and exposed to liquid nitrogen, or pelleted by filling indentations in dry ice with .2 ml aliquots of extended semen, then plunged into liquid nitrogen following a ten minute equilibration time.

When dealing with very small ejaculate volumes such as in the domestic cat, extended semen was frozen in as little as 0.05 ml aliquots by separating it via air bubbles from the upper and lower portions of the 1/4 ml straw which were filled with extender alone. This technique allows the small sample to be aliquoted into several straws and, thus, permits future evaluation of a representative sample without sacrifice of the entire frozen ejaculate, as well as greater experimentation in freezing/thawing procedures per collection.

Frozen samples were maintained in liquid nitrogen for one week or longer until thawing. Straws were placed in 35-37°C waterbaths for 30 seconds and pellets were dropped into 12 x 75 mm culture tubes held in a 35-37°C waterbath, with subsequent vigorous agitation of the tube for 45 seconds. Thawed samples were evaluated for percent motility and percentage rates of forward progression.

Using the domestic cat as a model, to date over 50 attempts at semen collection and preservation have been made. The extender most effective for cryopreservation in this species, as determined by other investigators and supported by this extensive study, is 11% lactose, 20% egg yolk and 4% gylcerol. An equilibration time of one-half hour cooling to 10°C yielded best recovery rates post-thaw of up to 80% motile cells and 65% good rate of forward progression. This same procedure was also found to be superior in the Jungle cat and cheetah, with both species yielding approximately 50% to 80% motile sperm after thawing. Freshly prepared Tyrode's salt solution (with 1 gram sodium bicarbonate per liter), 20% yolk and 4% glycerol has also proven very effective and has, on occasion, yielded 20-30% higher motilities than the 11% lactose extender. Liveability of sperm collected from the Persian leopards, however, was comparatively brief. If left in seminal plasma, virtually all cells died within 30-45 minutes. This apparent fragility complicates attempts at cryopreservation and greatly lessens recovery of motile sperm from thawed samples. Of the extenders tried, none has repeatedly yielded greater than 25% motile cells upon thawing. Ongoing studies will, however, involve centrifugation of samples to remove the sperm from the seminal plasma.

To date, no significant difference between thawed samples frozen in straws or by pelleting methods has been found by these authors. Due to ease of identification, and protection from bacterial contamination, freezing in straws is usually the preferred method. Glycerol levels greater than 6% (v/v) sometimes appear to be toxic to the felid sperm, resulting in lower rates of motility both before and after the freeze.

Much work waits to be done. Numerous extenders and various freezing rates remain to be tested. The most crucial link in this chain, however, is found in the female of the species. Major efforts must now be directed toward studies of prediction and induction of ovulation in the exotic cats, through behavioral and endocrinological research.

Techniques of non-surgical artificial insemination, especially in many smaller species, remain to be tested and proven with freshly collected semen before frozen semen is used due to unanswered questions of true viability of these samples.

One final point cannot be overemphasized. Due to the tremendous amount of knowledge still lacking in all of these areas, the only possibility for future successes of any effective number lies in the development and nourishment of cooperation, partnership and long-distance sharing of ideas among investigators.

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MONTEREY BAY AQUARIUM EDUCATION PROGRAMS - THE FIRST YEAR

by Bruce Stewart

First year priorities were Aquarium Guide training, school programs, and evening and summer programs for members.

AQUARIUM GUIDE TRAINING

300 volunteer Aquarium Guide Trainees completed a 48 hour Introductory Guide Training Course in the winter and spring of 1984. Since the aquarium was under construction, this course was taught at a local community college. The major focus of this course was natural history of Monterey Bay. The large number of trainees and lack of access to the aquarium dictated a slide/lecture format interspersed with interactive interpretive skits. Three units of college credit were available through the community college and a nearby state university. That summer, trainees completed one of six 15 hour Specialty Courses. Five of these courses focused on interpreting a specific gallery (eg. Kelp Forest or Marine Mammals) and the sixth on general interpretive techniques, tour guiding, etc. Specialty Course format was demonstration, small group practice and discussion. Imagination was a key ingredient in practice sessions since many of the exhibits to be interpreted were still under construction. In winter and spring of 1985, 90 additional trainees completed a second Guide Training Course which combined aspects of both introductory and specialty courses. 40 of these trainees were concurrently volunteering as apprentices under the supervision of Aquarium Guides. Bimonthly Guide Enrichment Evenings provide Guides with continuing educational opportunities.

SCHOOL PROGRAMS

Early interactions with county and district school superintendents, administrators and teachers have resulted in high level institutional support for aquarium visits by schools. Fifty teachers serve on k-2, 3-5, 6-8, 9-12 and special education School Advisory Committees (SACs). These committees suggest programs and materials to meet needs of students and teachers, and pilot and evaluate programs and materials. Several SAC members are also Aquarium Guides, have helped with Guide Training and Teacher Orientations, and have presented teacher workshops for the aquarium. Over 2500 teachers have taken advantage of free Teacher Orientations at the aquarium. Since opening in October, over 70,000 school children have visited. Reservations increased steadily from about 6,000 in November to nearly 18,000 in May (figure 1). The expected spring increase in reservations was boosted by the announcement in March of free entry to local school districts and reduced prices for outlying districts. 18.5% of the reservations represented students in grades K-2, 33.5% represented grades 3-5, 26.4% represented grades 6-8, 12.8% represented grades 9-12 and 8.6% represented college and adult education groups (figure 2). Program choices were Guided Tour, Self Guided Tour, Discovery Labs, and Auditorium Programs. Since lab and auditorium programs were not offered until March, most reservations represented either teacher-led Self-Guided Tours (57,107) or Guided Tours (12,914), led by volunteer Aquarium Guides. 5,052 reservations were made for Discovery Labs and 7,660 for Auditorium Programs (figure 3). Due to cancellations and no-shows, reservation numbers were 13% greater than actual numbers visiting. Instructor led Discovery Labs were 50 minute, hands-on sessions in two aquarium classrooms. Discovery Lab topics were Tide Pool Discovery (k-2), Exploring Rocky Shores (3-5), Undersea Forests (6-8), and Kelp Forest ecology (9-12). The 45 minute Auditorium Program topic was Secrets of the Aquarium, a behind the scenes look geared to the appropriate grade level (3-12). Initially, school program fees were $2.50 for grades k-8 and $3.50 for grades 9-college; however, thanks to outstanding general attendance the aquarium was able to provide free school visits for our three local school districts. A grant from Chevron USA has made it possible to lower fees for outlying schools by $1 per student.

MEMBER PROGRAMS

100,000 strong, aquarium members represent an important education program audience. The Education Department has worked closely with the membership manager in providing programs for evening members' events. Over 3,400 members attended slide talks on sea otters and kelp forests during Member Nights, and another 150 members attended a series of lectures on coral reefs, kelp forests, and the Sea of Cortez. The Education Department also provided a treasure hunt, fishprinting activity and movies for Grandkids' Night. Summer programs were advertized only to members, but were available at a higher fee to non-members. These included weeklong marine biology workshops for ages 6-18, morning and afternoon family workshops, family and adult field trips to the rocky intertidal and mudflats, natural history auditorium programs for adults, and skindiving courses for ages 12 to 18 in the Great Tide Pool exhibit and adjacent ocean waters.

Bruce Stewart, Monterey Bay Aquarium

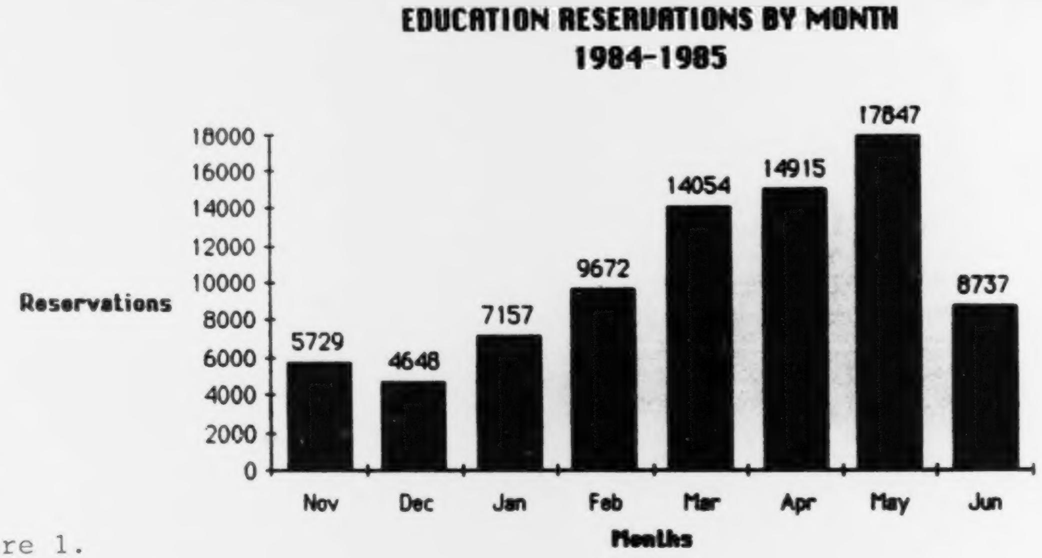

Figure 1.

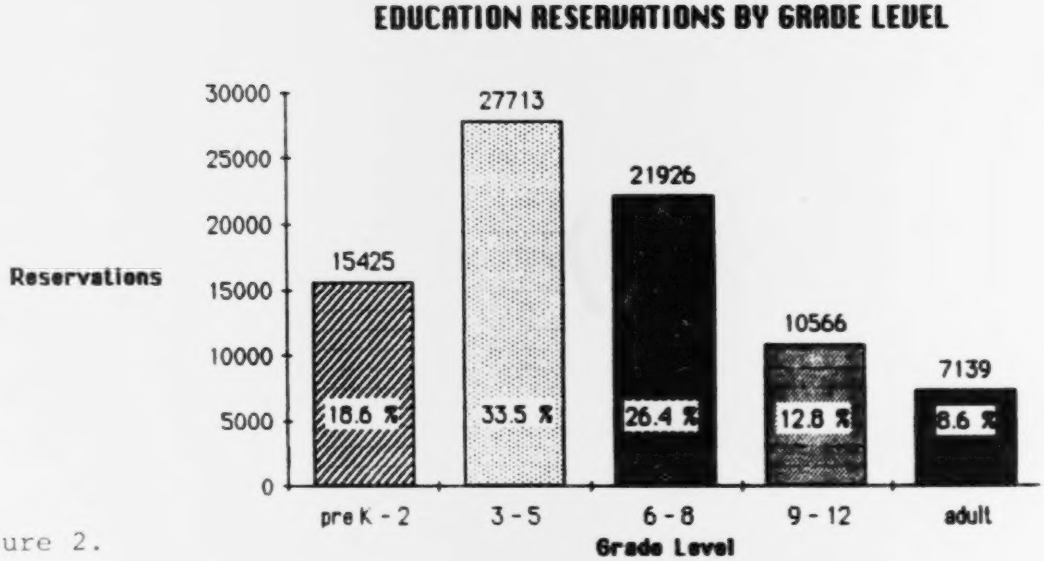

Figure 2.

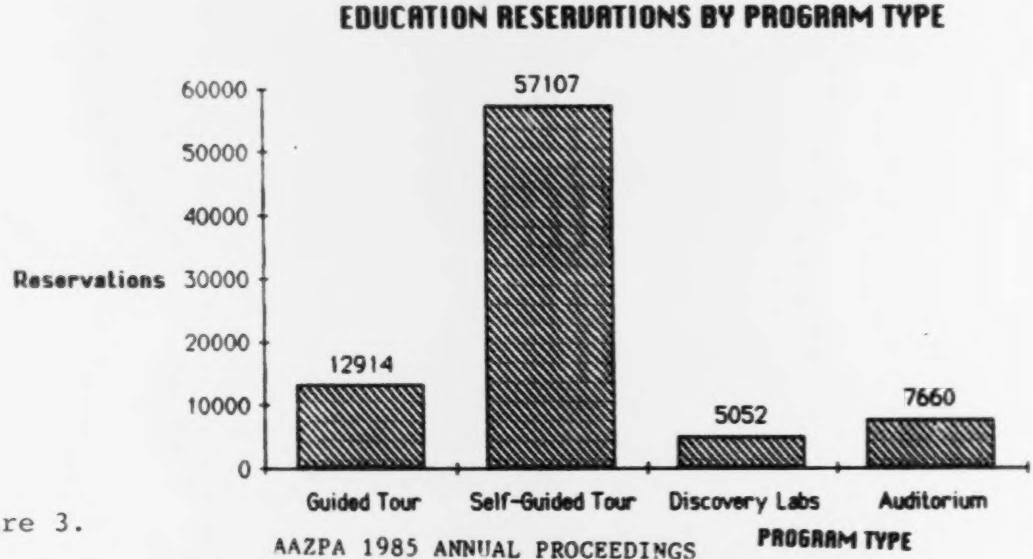

Figure 3.

SEROLOGICAL STUDIES ON THE RED CELLS OF A GORILLA FAMILY

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Primates share many erythrocyte antigens with humans, so human antisera, with modification, can be used to test primates for red cells antigens and antibodies. The Transfusion service of The Ohio State University had the opportunity to test the blood of a family, as well as other individuals, of lowland gorillas living at the Columbus Zoo.

The objectives of the study were to investigate the antigens of four generations of gorillas and investigate the possibility of hemolytic disease of the newborn as a cause of repeated miscarriages in Toni, who had been mated with her brother, Oscar.

Materials and Methods

Gorilla blood was collected by venipuncture and transferred to plain 10 ml vacuum tubes and 10 ml citrate phosphate dextrose vacumm tubes, mixing well to prevent clotting. Reagent human antisera were used throughout.

Three reagents were modified by absorption. Gorillas are known to possess the Rh antigens D and c. In order to prove that the positive reactions were valid and not interspecies incompatibility, both anti-D and anti-c were absorbed with human red cells possessing the corresponding antigens. The absorbed reagents were then used as controls in the typing of the gorilla red cells. The antihuman globulin (Coombs) reagent was absorbed with gorilla red cells to remove interspecies antibodies. The absorbed antiglobulin was then used as Coombs serum for testing.

The typings performed on the gorilla red cells were ABO, Rh (D, C, c, E, and e), MNSs, Duffy (Fy), Kidd (Jk), and Lewis (Le). The tests were done by standard blood banking agglutination technique according to manufacturers' instructions, with the addition of the control and absorbed sera described above.

In addition, the serum of each gorilla was tested against several examples of human red blood cells. Toni's serum was also tested against each of the gorilla's red cells, i.e., by crossmatching.

Results

All gorillas were found to possess the antigens B, N, c, and Le^b and to lack the antigens A, C, E, e and Fy^a (Table I). Although all gorillas were found to be positive with anti-D (with negative controls), 4 of 11 individuals were only weakly positive, compared to strong positives with the others. The inheritance of the weakened antigenic expression is shown by the pedigree shown in Figure 1.

One gorilla was not tested for Fy^b and Jk^a; however, all other gorillas were positive for these antigens. Polymorphism was observed with M, Le^a and S as reported in the literature.[1]

Toni and Oscar were both found to have antibody in their sera which reacted with all human red cells tested. Oscar's serum did not react with other gorillas' red cells. However, Toni's serum reacted weakly with the red cells of all other gorillas except Bongo, her father.

Discussion

As previously reported,[1] gorilla red cells share many antigens with human red cells. Unexpectedly, we found, with the testing of four generations, an inherited weakened expression of the Rh antigen D (Rho). This may be analogous to the weakened expression seen in humans called D^u. However, in humans, the weakened expression can be due to interaction of the C and D genes being on opposite chromosomes. However, this mechanism could not explain the finding in gorillas, which do not have polymorphism in the C gene. Humans can also have inherited weakened expression of D due to missing one of four parts of the D antigen. However, this type of D^u in humans is very rare.

We also found antibodies in the sera of Toni and Oscar directed against human red cells. Since both gorillas had close contact with humans during their infancy, this finding is not surprising. However, the finding of antibody in Toni directed against other gorillas would correspond to the antibody in a woman stimulated by pregnancy of an antigenically different fetus. The condition resulting from such mother-fetus incompatibility is termed hemolytic disease of the newborn. The disease has also been termed "Rh disease," "blue baby" and "erythroblastosis fetalis." The antibody crosses the placenta, coating the fetal red cells. The cells are destroyed by the fetal spleen, leading to anemia and, if severe, heart failure and death.

Antibody in mothers can also contribute to fetal wastage through miscarriage. Whether Toni's antibody caused her repeated miscarriages can only be conjectured. However, fetal wastage can also be due to the inheritance of lethal genes when closely related matings occur.

With the next preganancy, Toni should be repeatedly tested for antibody directed against her mate's red blood cells. In addition, future studies of the histocompatibility antigens and antibodies may help in the elucidation of her repeated miscarriages.

Reference

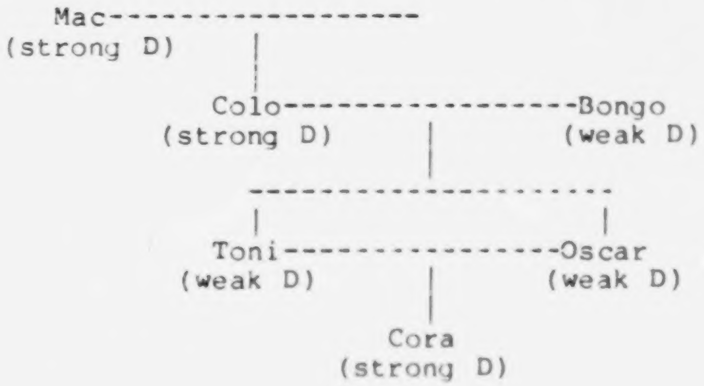
1. Socha, Wladyslaw W. and Ruffie, Jacques. Blood Groups of Primates: Theory, practice and evolutionary meaning. Alan R. Liss, New York, 1983.

Table I: Red Cell Antigen Testing Results

							Antisera								
Gorilla	ABO	D	C	c	E	e	M	N	S	s	Fy^a	Fy^b	Jk^a	Le^a	Le^b
Mac	B	+	0	+	0	0	+	+	0	+	0	+	+	0	+
Colo	B	+	0	+	0	0	+	+	0	+	0	+	+	0	+
Bongo	B	±	0	+	0	0	0	+	0	+	0	+	+	0	+
Toni	B	∓	0	+	0	0	+	+	0	+	0	+	+	0	+
Oscar	B	∓	0	+	0	0	0	+	0	+	0	+	+	0	+
Cora	B	∓	0	+	0	0	0	+	0	+	0	+	+	0	+
Muke*	B	±	0	+	0	0	+	+	0	+	0	+	+	+	+
Bridgett*	B	∓	0	+	0	0	+	+	0	0	0	NT	NT	0	+
Mumba*	B	+	0	+	0	0	0	+	+	+	0	+	+	+	+
Sunshine*	B	+	0	+	0	0	0	+	0	+	0	+	+	0	+
Lulu*	B	+	0	+	0	0	+	+	0	+	0	+	+	+	+

NT = not tested
* unrelated individuals

Figure 1: Gorilla Pedigree


Mac
(strong D)
Colo
(strong D)
Bongo
(weak D)
Toni
(weak D)
Oscar
(weak D)
Cora
(strong D)

EVALUATION OF THE
FIRST SPECIES COORDINATOR AND STUDBOOK KEEPER WORKSHOP

FRONT ROYAL, VIRGINIA, AUGUST 13-17, 1984

Prepared by Jonathan Ballou for the Species Survival Plan Subcommittee
of the American Association of Zoological Parks and Aquariums

This report outlines the results of a survey distributed to participants of the First Species Coordinator & Studbook Keepers Workshop held at Front Royal, Virginia in August, 1984. The survey was designed to census the participants' impressions and interpretations of how well the workshop met not only its own goals but the expectations and goals of the participants themselves.

The purposes of the survey were to: 1) determine how well the workshop achieved its initial goals, as specified by the organizers; 2) determine what parts of the workshop were most effective in achieving these goals; 3) determine what long-term effects the workshop has had on the SSP and Studbook Programs; 4) canvass participants for agenda ideas for future workshops; and 5) determine existing problem areas in developing and implementing Studbook and SSP Programs.

The survey forms (See Attached Form) were sent to all participants of the workshop in late June, 1985. Although the survey was conducted 10 months after the workshop, it should never-the-less prove useful for evaluating how well the workshop succeeded in meeting its goals A total of 65 surveys were distributed. Thirty-nine of the forms (60%) were returned. This was considered a relatively low response rate for such a small group and was probably related to the long time lag between the workshop and the distribution of the survey.

The evaluation was conducted solely on the basis of the survey responses. It should be noted that any conclusions drawn from the survey are subject to the usual biases present in any survey, the most notable being the difference in response rates between those who feel strongly about an issue and those who do not.

PARTICIPANT RESPONSE

The first question of the survey was included to determine the respondent's involvement in the workshop. The choices were: Studbook Keeper, SSP Species Coordinator, both or neither. The responses were:

RESPONSES THE QUESTION 1:

"I attended the workshop because of my involvement in:"

CATEGORY	# Responded	% Responded
Studbook Keeper	4	10%
SSP Programs	8	21%
Both	24	62%
Neither	3	8%

Most of the responses returned were by those involved in both SSP and Studbook Programs.

MEETING THE OBJECTIVES OF THE WORKSHOP

The objectives of the workshop were well delineated by the organizers prior to the workshop:

> **"The basic purpose of the Workshop will be to better prepare**
>
> **(1) Species Coordinators to direct formulation and implementation of SSP Masterplans and;**
>
> **(2) Studbook Keepers to compile, manage and disseminate data in a manner optimal for management analysis.**
>
> **Therefore, there will be an attempt to**
>
> **(1) delineate the general objectives of any SSP program and masterplan.**
>
> **(2) explain more explicitly what is expected of SSP Species Coordinators and Studbook Keepers.**
>
> **(3) develop with Species Coordinators and Studbook Keepers the basic principles, processes, methods and technologies necessary and available for population analysis and management.**
>
> **(4) in particular, provide hands-on experience with microcomputer management and analysis of data for the Coordinator's and Studbook Keepers own species.**

In order to determine how the goals outlined by the organizers of the workshop corresponded with the goals of those who attended, the participants were asked to state their own reason for attending. A synopsis of the participants objectives is as follows.

	RESPONSES	
STATED OBJECTIVE	#	%
Learn Methods to Computerize Studbooks	10	(26%)
Develop Better Understanding of SSP and Studbook Programs	9	(23%)
Learn More about Computerized Methods for Managing Endangered Species	5	(13%)
Learn How to Use Computers	4	(10%)
Learn Data Analysis Techniques	4	(10%)
Learn more about standard data structures for computer data bases	4	(10%)
Develop a SSP Masterplan	3	(7%)

The most common objectives were those of developing a better understanding of the SSP and Studbook Programs and learning to computerize Studbook data. These objectives coincided well with those of the organizers of the workshop. However, most of those interested in computerizing studbooks did not specify what aspects of studbook data management were of particular interest (i.e. learning how to produce a full studbook or just learning how to create a "studbook" data base for analyses).

To evaluate how well the objectives of both the organizers and the participants were achieved, the survey listed several questions relating to both group's objectives. Question 3 rated the workshop with regards to the participants' own objectives and Questions 6, 7 and 8 rated the workshop with regards to the organizers' objectives.

The responses to Question 3 ("My Objective was WELL PARTIALLY NOT achieved") are listed below. Overall, the participants' objectives were well achieved and there were no NOT ACHIEVED responses. This again suggests the close correspondence between the organizers' and participants' goals.

RESPONSES TO QUESTION 3:

"My Objectives were WELL PARTIALLY NOT achieved"

RESPONSE	# Responded	% Responded
WELL ACHIEVED	21	55%
PARTIALLY ACHIEVED	17	45%
NOT ACHIEVED	0	0%

The response to Question 6 ("Did you find the workshop useful in clarifying the role and objectives of the SSP and Studbook Programs?") suggested that the participants felt the workshop was highly successful in achieving its primary goal of developing a better understanding among participants towards the SSP and Studbook Programs. Many of those who responded only MODERATELY WELL attended the workshop in a capacity other than as an SSP or Studbook participant (i.e. lecturers, computer consultants)

RESPONSES TO QUESTION 6:

"Did you find the workshop useful in clarifying the role and objectives of the SSP and Studbook Programs?"

RESPONSE	# RESPONSES	% RESPONSES
VITAL	5	13%
VERY USEFUL	24	62%
MODERATELY USEFUL	11	28%
NOT USEFUL	0	0%

Question 7 ("Have you found the workshop experience helpful in developing and implementing your SSP Program or Masterplan") was directed to those specifically dealing with SSP Programs. Here the response was again good although the overall rating was not as high as in Question 6. Comments from those responding NOT USEFUL: "Sessions seemed hurried and goals minimal;" "I found it difficult to learn ... The distractions in the room along with the sub-group participation as each key was struck minimized my personal gains."

RESPONSES TO QUESTION 7:

"Have you found the workshop experience helpful in developing and implementing your SSP Program or Masterplan"

RESPONSE	# RESPONSES	% RESPONSES
VITAL	2	6%
VERY USEFUL	18	53%
MODERATELY USEFUL	10	29%
NOT USEFUL	4	12%

Question 8 ("Have you found the workshop experience helpful in compiling, managing and analysing your studbook data?") was directed at those specifically dealing with Studbook Programs. Here there seemed to be a greater variety of responses. There were several VITAL responses but also a rather large number of MODERATELY USEFUL responses. The only NOT USEFUL response came from the same participant who rated the previous question (Question 7, above) NOT USEFUL and commented that the sessions seemed hurried. The variety of responses suggested that there were mixed goals among those interested in the Studbook aspects of the workshop although this could not specifically be determined from the survey.

RESPONSES TO QUESTION 8:

"Have you found the workshop experience helpful in compiling, managing and analyzing your studbook data?

RESPONSE	# RESPONSES	% RESPONSES
VITAL	5	16%
VERY USEFUL	11	35%
MODERATELY USEFUL	14	45%
NOT USEFUL	1	3%

A particularly important goal of the workshop was to expose participants to the use of microcomputers in developing Studbooks and SSP programs. Question 10 ("How much microcomputer experience did you have prior to the workshop") indicated that over half (60%) of those who responded had little or no experience with microcomputers. The response to Question 11 ("Have you found the hands-on computer experience at the workshop useful in your SSP/Studbook Program?") indicated that the workshop was indeed useful in this capacity:

RESPONSES TO QUESTION 11:

"Have you found the hands-on computer experience at the workshop useful in your SSP/Studbook Program?"

RESPONSE	# RESPONSES	% RESPONSES
VITAL	4	10%
VERY USEFUL	15	40%
MODERATELY USEFUL	12	32%
NOT USEFUL	7	18%

Two of the NOT USEFUL responses were from participants not directly involved with SSP Programs or Studbooks; three were from participants who felt the hands-on demonstrations were too crowded or hurried; and two gave no reason. The overall response to this question was probably not higher because many participants do not yet have access to computers.

SUMMARY: The goals of the workshop as outlined by the organizers seemed to correspond fairly well with the goals of those attending the workshop. This can be attributed primarily to the organizers' recognizing the immediate needs of the participants and developing the agenda to address these requirements. Overall, the workshop was successful in achieving its goals and many respondents indicated that it was vital to their understanding of SSP and Studbook programs. There seemed to be an indication that the workshop did better at achieving its goals with respect to SSP Programs than to Studbook Programs, although both aspects of the program were highly rated. The hands-on computer demonstration at the workshop also seemed to be highly successful at exposing participants to microcomputer applications to species management.

THE WORKSHOP FORMAT AND PRESENTATIONS

Vital to achieving the objectives of the workshop was the method in which the materials, lectures and demonstrations were presented. Questions 4, 5, 9 and 12 were included in the survey to determine the effectiveness of the presentations and materials as well as to canvass the participants as to which part of the workshop they felt was most successful in achieving their goals.

Responses to Question 4 ("Was the information presented at the level you needed and/or you could understand?" Responses: 38 YES, 2 NO) indicated that for the most part the information was at an appropriate level, but that several demos and lectures were too technical. Many of those who responded YES to this question but commented that some information was too difficult also commented that there was always help available from someone in their group. Here the working group format of the workshop (small but diverse groups) seemed to be a valuable asset to conveying the more difficult material that was presented.

One NO response was from a participant who had no previous computer experience while the other responded both YES and NO and commented that some, not all, of the information was too technical.

Some of the comments: "At times it was somewhat confusing but help was always there;" "I could reap much greater benefit from the next one simply because I now know enough to ask questions;" ". . . a bit overwhelmed by the biological complexities of the inbreeding and population stuff;" "YES - but there was too much and went too fast."

Question 5 ("Were there adequate opportunities to participate in discussions and ask questions?") received 38 YES responses and one NO response. Many of the comments indicated that this was one of the most effective parts of the workshop: "Other than the lectures, thats' about all we did for 5 days was talk;" "The abundance of non-structured discussion time was useful for following individual ideas and interests." However, there were a couple of comments that it was difficult or awkward to ask questions during the lectures and large group presentations.

The opportunity to "talk-shop" after the structured lectures was an important part of the workshop and allowed ample time for individual instruction and one-on-one demonstrations: "I was amazed at the number of people working on the computers after-hours."

RESPONSES TO QUESTION 12:

"Have you found the written material handed out at the workshop useful?"

RESPONSE	# RESPONSES	% RESPONSES
VITAL	10	26%
VERY USEFUL	13	34%
MODERATELY USEFUL	15	40%
NOT USEFUL	0	0%

Question 12 ("Have you found the written material handed out at the workshop useful?") was included to evaluate the effectiveness of the written material distributed at the workshop.

The overall rating was very high and two participants felt that the written material was the most valuable aspect of the workshop (Question 9, below). Several indicated that they frequently refer to the notebook: "I read my book often when I have certain questions;" "Many good articles and examples to refer to." The responses indicated that the notebook was considered an important "take-home" product of the workshop.

RESPONSES TO QUESTION 9:

"What part of the workshop do you feel was of the most value to you?"

RESPONSES	Responses #	%
Hands-on Computer Experience	21	54%
Formal Lectures and Presentations	15	38%
Computer Demonstrations	13	33%
Discussions	8	20%
Workshop Notebook	2	5%

The hands-on computer experience was by far the most valued experience at the workshop. Comments with this question indicated that this was primarily because so many participants had little previous exposure to computers. Also: "Lectures were covered in the book, demos usually imparted neat but not retainable info. Hands-on was best but still did not allow enough time to get to know it."

SUMMARY: The level and methods with which material was presented at the workshop were rated favorably by the participants. Although several thought some of the material was too technical, they recognized the difficulty of presenting this type of information to such a diverse group. This problem was considerably reduced by the easy access to "teachers" within each small working group and the ample time to discuss problem areas after the structured lectures. In fact, the free or unstructured time during the workshop seemed vital to achieving the workshop's goals, both in terms of providing time for discussion and allowing additional time for hands-on computer experience. The Notebook was considered very helpful and is still being used by many who attended. However, the hands-on computer experience was considered the most valuable aspect of the workshop overall primarily because it gave many participants their first exposure to computers.

RESULTS OF THE WORKSHOP

Question 13 ("What do you see as the most significant result of your attending the workshop?") was included to determine what the effect or long-term results of the workshop have been. The responses were:

RESPONSES	Responses #	%
Better Understanding of SSP/Studbook Programs	22	61%
Production of the Preliminary Edition of a Studbook	6	17%
Better Understanding of Computers and Analytical Methods	4	11%

	Responses	
RESPONSES (Continued)	#	%
Better Understanding of Software Needs	2	6%
Development of Standard Data Sets for Studbooks	1	3%
Convince My Zoo to Buy a Computer	1	3%

SUMMARY: The most common result was a better understanding of the SSP and Studbook Programs. This again shows that the goals of the workshop were well met. Other significant results: Preliminary data sets were compiled on 6 studbooks (That is 10% of all published Studbooks) and, for one lucky individual, a computer, with which a new Studbook has already been published.

ADDITIONAL AGENDA ITEMS

Responses to Question 14 ("What items would you have recommended adding to the agenda?") were varied:

"Needed more computers for hands-on demos"

"Be more specific on how to develop Masterplans."

"Hear about other SSP Programs in a more formal manner"

"Run some examples of data analyses"

"More demonstrations of software packages"

"More time for hands-on work"

"Include a review of the SSP Guide"

"Demo on DBASE programming techniques and report generating functions"

"Volleyball - or some mandatory break during the week"

"Discussion of uniform data collection standards"

"Discussion of data entry and verification techniques"

"More direct assistance with individual SSP Programs"

"Mainframe computer applications and benefits"

"Discussion of types of genetic analyses (electrophoresis)"

"Pre-workshop meeting to cover basic computer techniques"

"Discussion of alternative methods for those who don't have computers"

SUMMARY: There was no one item that the participants felt was lacking from the agenda. In fact, the response was surprisingly varied and did more to reflect the diversity of the group attending than point to any gaps in the agenda.

SSP AND STUDBOOK PROBLEM AREAS AND FUTURE WORKSHOPS

Question 15 ("What do you feel are the major problems facing you in implementing your SSP or Studbook Program?") was included to highlight problem areas in these programs. Along with Question 16 ("Which of these problem areas would you like to see included in future workshops?"), it provided an opportunity for participants to suggest agenda items for future workshops. The results are tabulated as follows:

PROBLEM AREAS *# Responses*		SUBJECTS FOR FUTURE WORKSHOP AGENDAS *# Responses*
21	Insufficient time	3
9	Husbandry/captive breeding difficulties	6
5	Control of population growth rates	10
6	Lack of computer training	5
7	No access to computer	4
5	Difficulties in compiling studbook data	7
17	Lack of computer software for analyses	10
8	Difficulty in applying genetic mgmt. concepts	19
5	Difficulty in applying demographic mgmt. concepts	19

The following were written in under OTHER:

4	Lack of cooperation between zoos	2
0	Computer training	1
2	Managing populations with few founders	0
0	Use of genetic tools	1
1	ISIS standards	0
2	Grants and public funds for supporting SSP and Studbook Programs	2

As expected, insufficient time rated as the highest problem area followed by lack of computer software for analyses. Highest among the subjects suggested for future workshops were genetic and demographic management concepts, computer software for analyses and control of population growth rates.

CONCLUSIONS

The objectives of the workshop (to develop a better understanding of SSP and Studbook Programs and develop experience in microcomputer analysis of SSP and Studbook data) were well defined and clearly reflected the needs of those attending the workshop. The format of the workshop was successfully developed with achieving these goals in mind. The responses to the survey indicated that the objectives were well achieved and that the workshop was very successful in conveying information to all participants, despite the great diversity in the participants backgrounds and computer knowledge. The survey indicates that the success of the workshop can be attributed to:

(1) Organizing the workshop to meet the needs of the participants;

(2) Emphasizing hands-on computer experience;

(3) Providing ample time for discussions, small group demonstrations and opportunities to ask questions relating to the more formal lectures;

(4) Providing a workshop notebook with reference material to review during and after the workshop;

(5) Organizing small working groups consisting of participants with a diversity of experiences and backgrounds that enabled within group discussions and instructions; each group had at least one participant knowledgeable in each of the subjects covered.

The "take-home" lessons and long-term results of the workshop were exactly those intended by the objectives of the workshop: a better understanding of the SSP and Studbook Programs and the beginning of the long process of computer education and computerizing studbooks and SSP data. Perhaps the implication of these results was best stated by one of the participants: "SSP has been a word known only to a few . . . it is now becoming a word used by all in all departments."

The survey also provided a form for participants to indicate current problems with their SSP and Studbook Programs and make suggestions for future workshops agendas. Among the most common problems with both developing and existing programs were lack of time and computer software. Items for future workshops included additional coverage of genetic and demographic management concepts, software to conduct the required analyses, and control of population growth rates.

FINALLY . . .

Some comments from the participants:

> "I found the workshop to be the most valuable workshop that I have ever attended and I'm looking forward to future sessions"
>
> "I thought the workshop was very useful and should be extended to anyone interested and directly involved in SSP programs whether studbook keeper, species coordinator or not, i.e. invite PR people, educators, administrators, etc to promote support"
>
> "The most useful and far reaching consequence for myself and other participants seemed to be the excitement generated by the workshop: a not-insignificant value"
>
> "To listen to the accomplishments and problems of others helps to feel like you are not alone. The interchange was a shot in the arm to achieve more."
>
> "A valuable meeting which brought together a wide range of concepts into a neat package, with a wide range of people who 'learned' together."
>
> "The workshop was great, so much is still sinking in."
>
> "I feel there should be more time alloted for small group discussions/sessions which attempt to 'iron out' specific problems which may be unique to a particular SSP Program."
>
> "Overall the most helpful workshop I ever attended."
>
> "Lets do it again!"
>
> "I should have married my computer that week . . ."

1984 SPECIES COORDINATOR AND STUDBOOK KEEPER WORKSHOP

QUESTIONNAIRE FORM

Please respond by completing the statements below and returning the form in the enclosed envelope by July 10. Your response will be used to help plan future workshops in this and related fields. No signature is necessary. Additional comments may be written on the back of the form.

1) I attended the workshop because of my involvement in:

4 Studbooks 8 SSP Programs 24 Both Other: 3

2) My primary objective for attending the workshop was: See Text

3) My objective was WELL PARTIALLY NOT (circle one) achieved

Comment: 21 17 0

4) Was the information presented at the level you needed and/or you could understand? 38 YES 2 NO. Comment:

5) Were there adequate opportunities to participate in discussions and ask questions? 38 YES 1 NO. Comment:

6) Did you find the workshop useful in clarifying the role and objectives of the SSP and Studbook Programs?

5 VITAL 24 VERY USEFUL 11 MODERATELY USEFUL 0 NOT USEFUL

7) Have you found the workshop experience helpful in developing and implementing your SSP Program or Masterplan?

2 VITAL 18 VERY USEFUL 10 MODERATELY USEFUL 4 NOT USEFUL

8) Have you found the workshop experience helpful in compiling, managing and analysing your studbook data?

5 VITAL 11 VERY USEFUL 14 MODERATELY USEFUL 1 NOT USEFUL

9) What part of the workshop (lecture, demo, hands-on, etc.) do you feel was of the most value to you? See Text

WHY?

(PLEASE TURN OVER)

10) How much microcomputer experience did you have prior to the workshop?

7 EXTENSIVE 7 MODERATE 17 LITTLE 8 NO EXPERIENCE

11) Have you found the hands-on computer experience at the workshop useful in your SSP/Studbook program?

4 VITAL 15 VERY USEFUL 12 MODERATELY USEFUL 7 NOT USEFUL

12) Have you found the written material handed out at the workshop useful?

10 VITAL 13 VERY USEFUL 15 MODERATELY USEFUL 0 NOT USEFUL

13) What do you see as the most significant result of your attending the workshop? (i.e. initiation of a SSP/Studbook Program, publication of a Studbook, better understanding of SSP/Studbook techniques, objectives):

See Text

14) What items would you have recommended adding to the agenda? See Text

15) What do you feel are the major problems facing you in implementing or developing your SSP Program and/or Studbook?

Check below
↓

21	Insufficient Time	3
9	Husbandry/Captive Breeding Difficulties	6
5	Control of Population Growth Rates	10
6	Lack of Computer Training	5
7	No Access to a Computer	4
5	Difficulties in Compiling Studbook Data	6
7	Inaccuracy of Studbook Data	7
5	Difficulties in Analysing Studbook Data	13
17	Lack of Computer Software for Analyses	10
8	Difficulty in Applying Genetic Mgmt. Concepts	19
5	Difficulty in Applying Demographic Mgmt. Concepts	18
9	Other: See Text	5

↑

16) Which of these problem areas would you like to see included in future workshops? - - - - - - - - - - - - - - - Check above

17) Other Comments: See Text